

Technology Review

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Not enough . . .

Industrialization and
population growth
are eating up
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◆ CYBERDIVERSITY ◆ PATENT REFORM ◆ FROM DEFENSE TO HEALTH ◆ COSMIC DAWN

technology review

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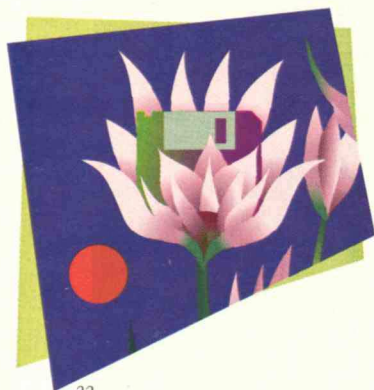
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First Line

Scientist, Explain Thyself

AN advertisement a few years ago for New York's Plaza Hotel featured a shot of Walter Matthau and his family enjoying breakfast there. The caption boldly declared: "Nothing unimportant ever happens at the Plaza."

Now Mr. Matthau is one of my favorite movie stars and I'd bet his family is a lovely bunch, but why was their morning meal such an important event? Don't we all eat breakfast, more or less every day, maybe even occasionally in fancy places?

Thus it seemed to me that the ad backfired: if the hotel's management deemed a routine breakfast significant, one might wonder whether *anything* important ever actually happens at the Plaza. Similarly, consider the packages most offices regularly receive from Federal Express and other overnight-mail services that identify the contents, however ordinary, as "Extremely Urgent." If everything is labeled extremely urgent, and nothing is ever unimportant, the audience grows skeptical and may ignore the arrival of something truly critical.

The erosion of trust that results from grandiose claims is not peculiar to commercial enterprises. Our own science and technology community, where research is invariably "of fundamental importance" to the welfare of the nation, is also at fault. Many such claims turn out to be true, but unless they are convincing to the public and its political representatives—unless scientists and technologists patiently explain in some detail why their work is so critical—the researchers will be perceived as just another self-serving interest group wrapping itself in glamorous but deceptive packaging, and consequently deprived of funding.

I fear that we're currently witnessing such a phenomenon—ironically, in response to something that truly is "nothing unimportant." Initiatives led by Republicans in the House of Repre-

sentatives—in the spirit of balancing the federal budget, cutting unnecessary governmental costs, and furthering the ideology that the marketplace knows best—would steadily and significantly reduce federal support of science and technology over the next seven years. By FY 2002, total funding for nondefense R&D, under current House proposals, would be some 33 percent lower than in FY 1995, with agencies such as NASA, the National Science Foundation, and the Department of Energy taking major

Researchers need a better strategy for fighting threats to federal funding.

hits in both their structure and the work they support.

If all this comes to pass, numerous projects will be cut back or eliminated, and the impact on many scientists' and technologists' careers will be profound. In lots of cases, the ultimate effects on society could also be profound. But the R&D community has been responding to this crisis mostly with blunt instruments, rarely venturing beyond the vague generalization. We hear warnings that the House proposals will have "serious ramifications for the entire nation," but we do not hear case-by-case arguments for reinstating each funding cut deemed misguided.

Problem is, *all* the cuts are apparently deemed misguided by spokespersons for the R&D community. But when research is represented in monolithic terms, as if every contribution were of equal merit, it becomes impossible for legislators to weigh the value of each potential investment, and a major opportunity to reach them is lost.

Granted, it's not easy to be specific about the long-term benefits of individual R&D projects. But surely researchers in each case have some initial ideas—however fuzzy, limited in scope, or ulti-

mately incorrect—on where their work may lead, and can offer them in candor as a starting point. This would be a lot better than the verbose attempts to brand the entire science and technology enterprise extremely urgent, which amounts to saying nothing.

Luckily, the scientists who would have the hardest time predicting the outcomes of their work are off the hook: Republican budget-cutters generally have no problem with basic research, which they view, at least in principle, as legitimate for public funding. They need to be convinced, however, about applied research. But this is by definition a lot easier for researchers to match with intended pay-offs: in the applied arena, they usually know what practical ends they seek, and why public funding in many cases might make more sense than private. Thus the R&D community has little excuse for not being more articulate about the anticipated benefits of most of the projects now actually slated for cuts.

Because it would acknowledge the practical needs of legislators, such specificity would be part of the "long-neglected dialogue with the political system" that Rep. George E. Brown, Jr. (D-Calif.), writing in this issue of *Technology Review* ("Scientists and Engineers as Political Advocates," page 40), urges researchers to cultivate. "The research community," he advises, "must stress pragmatic and short-term returns on our R&D investment rather than the loftier goals of expanding human understanding."

Neal Lane, director of the National Science Foundation, sounded a similar theme in a symposium last summer convened by the American Association for the Advancement of Science. Along with the privilege of receiving taxpayer support, he said, researchers have "the responsibility to explain to the American public the contributions that science and technology make in meeting the goals of the nation and its citizenry. It is only then that we can expect society to truly understand and value those contributions."

—STEVEN J. MARCUS

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Letters

RECALLING THE DAYS THEY DROPPED THE BOMB

I disagree with author John W. Dower's assertion in "Hiroshima, Nagasaki, and the Politics of Memory" (*TR August/September 1995*) that the scaled-back Enola Gay exhibit at the National Air and Space Museum denied the American public "a rare opportunity to use the fiftieth anniversary of Hiroshima and Nagasaki to reflect more deeply about these world-changing developments." The public was spared the original, seriously flawed exhibit that, through omission and selective editing, painted a distorted picture of the Japanese in World War II as the victims and the Americans as the racist aggressors. Far from thoughtful, it did little to capture the many nuances and complexities surrounding the decision to drop the bomb.

Out of the original exhibit's 302 pages of text, only three referred to the Japanese atrocities before or during World War II while 99 pages covered the devastation in Hiroshima and Nagasaki, the Japanese casualties, and the suffering and damage from earlier B-29 firebombings. Likewise, there were 49 photos of Japanese casualties and only three of American casualties. Ten months and four text revisions later, there were improvements in balance and context. But by then, the issue had become a political hot potato and the ideological content of the exhibit was dropped.

Brief wall labels, photographs, and artifacts are not the easiest medium for conveying complicated issues. The introduction of ideology makes the task impossible. The exhibit that finally opened contains none of the original distortions. Along with a very focused technological display of the Enola Gay, there are explanations of the B-29's technical achievements, details of the 509th Composite Group's mission, a video of the crew's recollections, and an outstanding collage of newspapers from August 7, 1945, the day after Hiroshima was bombed. Those who

take the time to read the articles will find in them many of the issues that are still being debated today.

STEPHEN P. AUBIN
Director of Communications
Air Force Association
Arlington, Va.

John W. Dower writes that "In the end, one of the great legacies of World War II was the redefinition of the legitimate targets of war to include noncombatant women, children, and men." To the contrary, this has been a policy of U.S. warfare since our earliest days when pox-ridden blankets were distributed to native tribes with the intention of

wiping them out. During the Civil War, the Union Army destroyed crops in the Shenandoah Valley to deny them to the Confederates and burned houses and barns there in retaliation for the deaths of Union officers.

At the turn of the twentieth century, U.S. troops carried out wholesale slaughter in our new colony, the Philippines, to pacify the inhabitants, who mistakenly had assumed that our defeat of the Spanish meant independence for them.

The episode in the Philippines also contradicts a point made elsewhere in the same issue, by Robert J. Lifton and Greg Mitchell in "The Age of Numbing," that "Hiroshima was the mother of all cover-ups: it spawned patterns of distortion, manipulation, and concealment that have contaminated American life ever since." If anything, the cover-up by the U.S. press of the atrocities in the Philippines was more effective because the protests of the leading citizens of the time, including author Mark Twain, were simply smothered. Can any American now recall this disgraceful incident?

Dower, Lifton, and Mitchell are naive in fancying that Americans were "nice guys" until only recently. Sad to say, we've had our little lapses throughout our history. Like Hiroshima, said lapses



did serve their purposes at the times they happened, and, of course, the winners wrote the history books—which apparently, these authors read.

G. RAY FUNKHOUSER
Fort Washington, Pa.

John W. Dower speculates that the Japanese would have surrendered “probably by November 1—without the atomic bombs, without the Soviet entry, and without an invasion.” With the Japanese military firmly in control and the populace prepared to fight to the death of the last citizen, Dower’s estimate isn’t even slightly reasonable.

JAMES F. HIELD
Lake Ozark, Miss.

A NEEDLING OBSERVATION

Since sewing needles sold in the United States have been made and packaged in Japan for years, your illustration on page 63 of the August/September 1995 issue—showing U.S. ambivalence about the atomic era by way of a needle packet—reveals even more ambivalence than you realized.

MARGARET P. HOLTON
Seattle, Wash.

THANK THE HAWKS

Prompted by the 50th anniversary of the end of World War II, the media in general—and *Technology Review* (August/September 1995) in particular—were rife with commentaries on the use of the atomic bomb. Included in these collections were the discourses of “revisionists” who claim that the bombings of Hiroshima and Nagasaki were inhumane and even unnecessary to save lives and shorten the war. We strenuously disagree.

Only something on the unprecedented scale of these atomic bombs could have quickly ended the war, thereby sparing the millions of individuals on both sides who would have been killed or seriously injured in land invasions of Japan. And we are sure that there was no alternative to such invasions because the firebombings (with conventional weapons) of Tokyo, Yokohama, Kobe, and other

industrial centers, which were actually more destructive than the two bombs of August 6 and 9, did not force the Japanese to surrender. They respected the power of the atomic bombs, however. Postwar interviews revealed that Japan was working on its own version, and would have used it on us if it were ready.

EDWIN G. ROOS, New York, N.Y.

FRANK CHIN, Brookline, Mass.

LOUIS R. DEMARKLES, Hyannis, Mass.

A BALANCED SERIES

Congratulations on your magnificent special issue, “The Atomic Age at 50” (*TR* August/September 1995). When today’s instant experts pass judgment on issues that they know nothing about, it is refreshing to read an authoritative and well-balanced set of essays on many facets of this awesome subject.

From a pragmatic viewpoint, two indisputable facts emerge: World War II stopped shortly after “the bomb” and no major wars occurred in the ensuing half-century. From a speculative viewpoint, your writers could have projected a scenario in which Japan was the ultimate victor. Hard to believe, but possible. I would have dropped not two but ten bombs to guard against that eventuality.

ITALO S. SERVI
Winchester, Mass.

Congratulations on your August/September issue. I thought you did a superb job of presenting various viewpoints on the bombings of Hiroshima and Nagasaki.

As one of those who was saved from an invasion of Japan by the use of the bomb and an observer of two blasts at Bikini in 1946, I have my own opinion. It is summed up in the following 14 lines of iambic pentameter:

The Road Not Taken

We travel down this road of life, and rest
At forks where one must pause to pick and choose.
A choice is made for what we hope is best,
Or oft, perhaps, on what we fear to lose.
At times these forks are seen both clear and bright;
They stretch across a flat and level plain.
Then others wind down valleys without light.
We know not where they end, in joy or pain.

So Hiroshima came, and we could peer,
But where it led was not for us to see.
One path was picked, its end is still not clear,
But knowledge of the other path will never be.
So fret not for these woes we see so clear.
The other’s woes, perchance, were twice as dear.
JACK C. PAGE
Dallas, Tex.

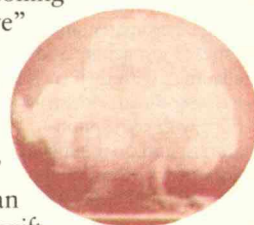
GENERAL CONVERSION

As a World War II veteran, I was appalled at the ignorance of history that editor Steven J. Marcus displayed in “Transforming a Superpower” (*First Line*, *TR* May/June 1995). He should also apologize for extolling a “Saturday Night Live” skit about the Nazis.

The editor’s assertion that Germany and Japan “ultimately won World War II” denies history. Japan and Germany moved swiftly into civilian pursuits because the United States provided them with long-term military protection in lieu of their own military power. U.S. generals, who quickly converted to peace (as did the rest of us), were excellent postwar statesmen. Gens. Lucius Clay and Dwight D. Eisenhower prevented France, the Soviet Union, and England from turning Germany into an agrarian nation. Gen. Douglas MacArthur guided Japan along the track to democracy and prosperity. Europe’s progress since the end of World War II depended heavily on the (Gen. George) Marshall Plan.

If the editor had acknowledged the U.S. military’s contribution after World War II, he would not have suggested that gender influences problem solving. A solution can simultaneously employ “competitiveness, battle, dominance, and well-defined movement toward singular solutions” and “collaboration, emphasis on process and growth, and a gentle, patient and flexible approach.” Forget Superman, Superwoman, and “Saturday Night Live”. They carry images important only for the TV generation.

PAUL M. ERLANDSON, SR.
Stamford, Conn.



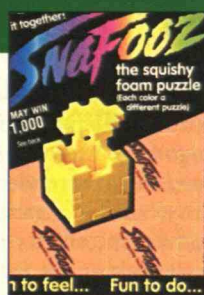
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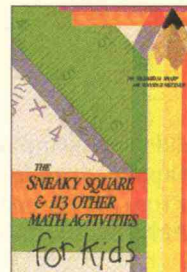
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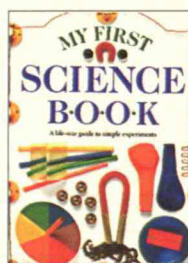


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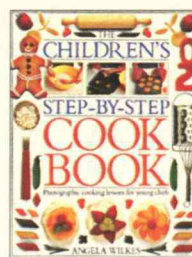


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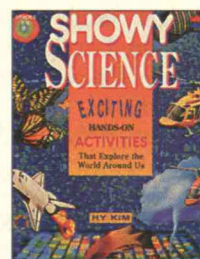
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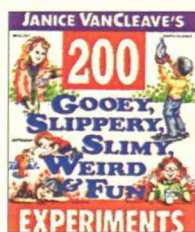
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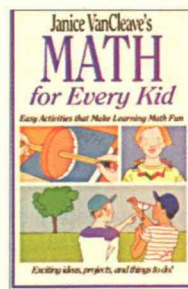


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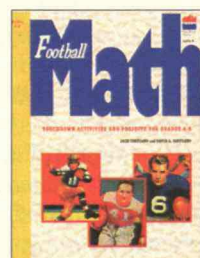
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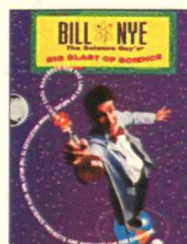


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LETTERS

DROPPING THE REACTOR?

I take exception to Theodore B. Taylor's premise in "A Ban on Nuclear Technologies" (*TR August/September 1995*) that the world would be a safer place with such a prohibition. No thanks, Mr. Taylor. If we must deny future generations the fruits of scientific achievement that can be life-threatening when used improperly, we best put away our knives and forks.

JEROME H. GOLDBERG

President

Nuclear Division

Florida Power & Light Co.

Theodore B. Taylor clearly enunciates the connections between nuclear power and nuclear weapons as well as the terrible possibility of turning nuclear facilities



into radiological weapons. Indeed, one of the consequences of the Chernobyl accident was the stark realization that what happened there by accident could also be made to happen by a planned attack. It therefore appears that humankind cannot have both nuclear technology and acts of war. Taylor correctly concludes we must learn to live without those technologies that release energy through fission or fusion.

Alternatively, Taylor notes that humankind must learn to rely on renewable energy resources and conservation. This approach must also include a realization that the other great threat to human civilization is overpopulation. With world population now growing at 93 million people per year, any energy supply scenario must face the realities of global growth in energy demand.

J. RICHARD SHANE BROOK

Professor

Union College

Schenectady, N.Y.

EXTRA HOMEWORK

In "Telecommuting: Preparing for Round Two" (*Trends, TR July 1995*), David Bjerklie's opening statement,

"Telecommuting is the technosocial megatrend that never happened," ignores the fact that the number of telecommuters in the United States totaled 10 million in 1995, and my own research indicates that by the end of 2000, there will be more than 20 million U.S. telecommuters and at least an equal number in the rest of the world. Does the entire workforce have to be telecommuting before Bjerklie recognizes it?

JACK M. NILLES

Los Angeles, Calif.

Nilles is the author of Making Telecommuting Happen (Van Nostrand Reinhold, 1994).

David Bjerklie completely misses the most significant result of the telecommunications revolution: instead of enabling employees to work at home instead of the office, they are now expected to work at home *in addition* to the office. Telecommuting caught on when managers realized that they could expect more work for the same salary. This shift has prompted many professional, especially technical, employees to work on an hourly contract basis without benefits. It is not so much the potential for increased income that is attractive, but that this is the only way to regain control of personal time.

JEAN RENARD WARD

Arlington, Mass.


CORRECTION

Because of an editing error, "Nothing Natural Could Have Caused This" by Carole Gallagher (*TR August/September 1995*) incorrectly stated that the U.S. Marines used Al Maxwell, who the Japanese had imprisoned near Hiroshima, to clean up after the bombing. In fact, it was the Japanese who put their prisoners to work during the days immediately following the detonation.

Continued on page 70

MIT Reporter

RECOGNIZING STARS IN AN AGE OF TEAMWORK

 When Ragged Dick, the plucky but penniless hero of a Horatio Alger novel, takes leave of a benefactor, he receives the following sage advice: "Remember that your future position depends mainly upon yourself, and that it will be high or low as you choose to make it." Indeed, in a remarkably short time, the lad hangs up his shoeshine box and is reborn as Richard Hunter, Esq., "a young gentleman on the way to fame and fortune."

The rags-to-riches story, today represented by best-sellers like *Iacocca: An Autobiography*, is a conspicuous example of America's romance with meritocracy—the principle that people ought to be rewarded in proportion to their talent, skill, and effort. But that cherished belief is on a collision course with the new realities of U.S. business, according to Maureen A. Scully, an assistant professor at the MIT Sloan School of Management. The rapidly spreading concept of teamwork, she says, is supposed to take the emphasis off individual achievement and encourage workers to cooperate in groups and learn from one another. Yet most employers still allocate raises and promotions on the basis of individual merit.

"The systems go by different names—pay for performance, pay for contribution, pay for skill, and pay for knowledge—but they all designate winners and losers," Scully complains. The tenor of working life when all are clamoring for recognition may not be conducive to building a community. "If you're trying to get teamwork and a sense of 'we're all in this together, we don't have a person to waste,'" she says, "that sense of shared ownership can be severely compromised."

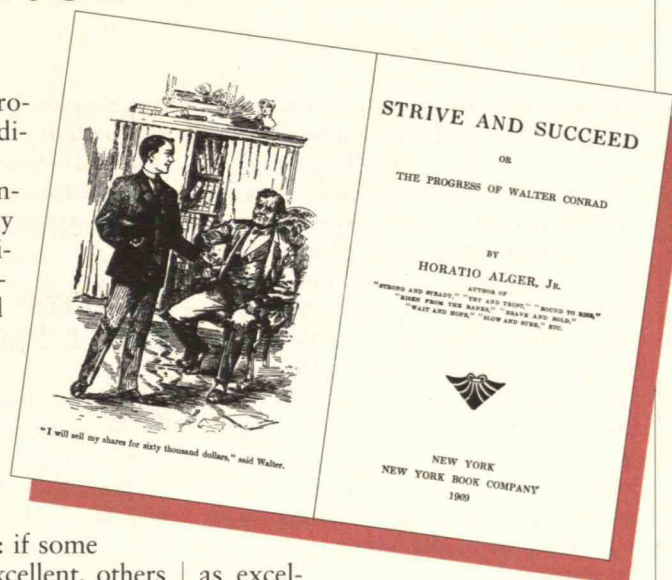
Scully bases this observation on a pair of studies she has devised. In one, she surveyed 425 workers at two companies on their attitudes toward merit-based reward systems. In the second study, still under way, she is examining the dynamics of teamwork at a large manufactur-

ing company where production workers are divided into 22 teams.

The sociologist concluded in her first study that meritocracy, as typically applied in U.S. companies, is a fallible and divisive practice. She found that performance evaluations—the main tool for judging merit—can be more demoralizing than motivating, especially when managers grade on a curve: if some workers are cited as excellent, others must be labeled only good or fair. "Although evaluations are supposed to encourage people to try harder, people can also say, 'Well, I tried really hard last year, and I got the lowest possible raise.'" Even the premise that merit-based systems actually reward merit is open to question, Scully found. Employees often attribute their co-workers' advancements to favoritism, luck, class or economic background, and uneven distribution of the best assignments.

W. Edwards Deming, the architect of Japan's team-based production approach, long ago concluded that merit rating was incompatible with teamwork because it penalizes people who seek to improve the overall system and encourages employees to work "as prima donnas, to the defeat of the company." Perhaps not coincidentally, Japan's reward systems are based on seniority.

Scully, however, is not recommending that U.S. companies scrap the merit system. For one thing, she has observed that workers want their organizations to recognize outstanding work. One company she studied had two merit programs—a bell curve, which employees hated, and a two-tiered system in which the workers with the most skill were given a special classification and higher pay. When management announced plans to remove the two-tiered system, Scully says, "people were up in arms. They liked the notion that there was a special 10 percent who were recognized



as excellent and who showed that you *can* get really good at your job. We like to have some stars; it gives us all a bit of reflected glory."

Some Practical Advice

As for how U.S. companies can tailor the traditional merit system to the exigencies of group work, Scully is full of ideas. For example, she says, teams could be allowed to vote on whether they wanted bonuses to be distributed equally within the group or according to each member's perceived contribution. "They could all get a 5 percent raise or else a few people would get only 1 percent, a few more would get as much as 5, others would get more than 5."

Scully says the workers she has interviewed "have a deep native understanding about the tradeoffs of this issue." They realize that equal distribution is more team-spirited but can encourage freeloading. And they are aware that proportional distribution is hard to decide objectively and penalizes those who don't toot their own horn. No doubt different teams would reach different conclusions about how to distribute rewards, says Scully. But the team approach already gives workers the power of self-management over a range of issues, "so why not this one as well?"

If company management retains the right to distribute raises, it ought to rec-

ognize that there are limits to the degree of incentive that arises from small differences in pay. "To think I'm going to sit here and say to myself, 'Ooh, I got 3.6 percent instead of 3.7—I'm now going to give a modicum of extra effort so I can get 3.7 next year' is a distorted view of human nature," says Scully. Far more sensible in cases where the pool for raises is modest, she says, would be to separate performance from pay altogether and give everyone an equal raise. There would still be opportunities to acknowledge merit. "Time can be as motivating as money. So exceptional work by an individual or by the whole team could be rewarded with comp time—or with time off to take a training course. Or if the team has rotating officerships, a good performer could be made project leader for the next project."

Likewise, companies must be careful not to use incentive systems to accomplish too many objectives, Scully warns. Firms that want to improve safety, for example, often try to "sideswipe" the problem by making it a line item on performance evaluations; they expect the chance of higher pay next year to make workers more safety-conscious this year. "Meritocracy distracts people from going at the problem directly," says Scully. "Instead, put aside 2 percent of your budget to train people in safety, or don't hire so many temp workers." Nor are evaluations the most efficient way to promote the kind of versatility required in teamwork. "If you want people to gain skills, provide training or apprenticeship programs. Don't say, 'If you happen to develop more skills, we'll raise your pay.'"

Finally, says Scully, companies should attend to the "vertical" pay scale—the difference between the highest and lowest wages within a company. The pay ratio at Fortune 500 corporations averages 85:1, she says. While most workers do not begrudge top management the highest pay—especially if they perceive CEOs as providing jobs and other social benefits—employees Scully has spoken with often complain that overly lavish salaries at the top contradict the

frugal spirit behind teamwork. "You can't convince employees that cost-cutting innovations like teamwork are necessary," she says, "when you have huge vertical pay gaps." —DAVID BRITTAN

THE LITTLE ENZYME THAT COULD

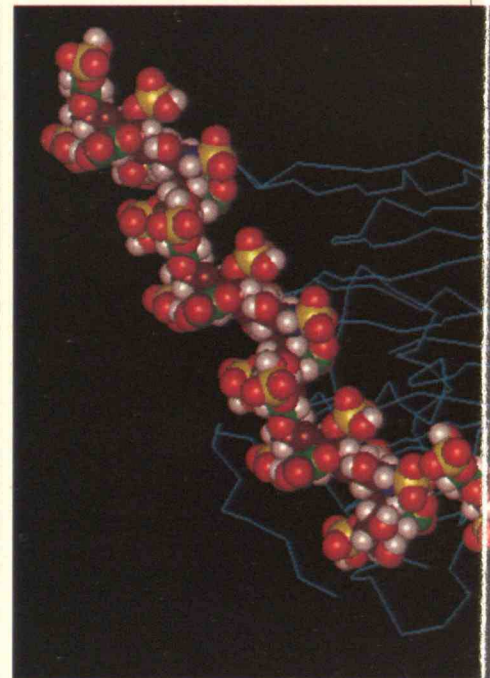


Open-heart surgery, which is performed more than 590,000 times annually in the United States, would not be possible without heparin. Lacking this drug, blood could clot in the tubing of the machines used during these procedures—and that could put the patient's life at risk. But doctors have to reverse heparin's action after such procedures, so that a person's blood can rapidly regain its ability to clot and thereby heal breaks in internal tissue and in the skin.

Thus to prevent complications from bleeding after open-heart surgery—or sometimes following other procedures—physicians today finish by administering a second drug, protamine, which binds to heparin, rendering it useless. But because the administration of heparin during surgery is not an exact science, gauging how much heparin remains in the person afterwards and therefore how much protamine to give can be difficult. Moreover, protamine sometimes leads to adverse reactions such as lowered blood pressure, difficult breathing, and a slow heartbeat, or does not work as well as expected.

Some 20 years ago, while studying enzymes—compounds that break up proteins and other substances—for his doctoral thesis at MIT, Robert S. Langer Jr. became intrigued with the problems surrounding the medical use of heparin. He conceived of a possible alternate therapy using heparinase, the enzyme that chops up heparin molecules. Now a professor of chemical and biomedical engineering, over the years Langer has gone on—with Charles L. Cooney, a professor of chemical engineering at the school—to found a virtual institute of heparinase research.

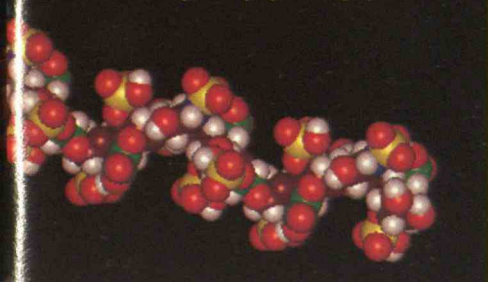
They and their team members have



developed ways to produce and purify forms of the compound from the best studied species—a soil bacterium—that naturally makes the enzyme. They have isolated the gene needed to make the enzyme by genetic engineering. They have safely deactivated heparin in lab animals by injecting heparinase into the bloodstream. And with results suggesting more research avenues, the engineers have spun off into work exploring whether heparinase could help halt rapid blood-vessel growth (a process critical in diseases such as certain forms of cancer), and developing a device that might be useful not only for administering heparinase but also for reducing the amount of the "bad" form of cholesterol found in the blood.

Among the companies interested in the work is IBEX Technologies of Montreal. IBEX finished its first human trial of injected heparinase this past summer, with the 24 healthy people who received the enzyme tolerating it well, says Robert Heft, president and chief operating officer of the company. The company began a second human trial in late August, giving first heparin and then heparinase to volunteers. Other trials

A model shows a molecule of heparin, a bloodclot-prevention drug used during open-heart surgery, starting to break apart (at the apparent angle in the picture) under the influence of an attached molecule of the enzyme heparinase (the stick figure). Researchers are conducting human tests of the process, which might help blood regain its clotting ability after surgery.



will follow; if all goes as well as hoped for during the clinical research phases required by the U.S. Food and Drug Administration, Heft notes, his company could receive approval to market heparinase by the end of 1998.

Preventing Allergic Reactions

Meanwhile, the MIT researchers have expanded their focus to developing a different way to deliver heparinase to heparin molecules. During the course of animal studies in the 1980s the Langer-Cooney team found that heparinase can trigger allergic reactions if injected more than once or twice in the same patient—a situation that could sometimes crop up. The researchers have therefore created a device that both keeps heparinase outside the body—so the compound does not meet up with critical parts of the immune system that would mount a response—and mixes the enzyme with heparin. The group has designed an instrument that could be installed in the machine tubing through which blood returns to a patient during, say, heart surgery. (The exposure to heparinase by only quickly flowing blood can't trigger an allergic reaction.)

The mixing device houses a filter made of synthetic beads, hollow cellulose fibers, or other materials that bind the heparinase so it can't enter the body—while still being able to react chemically with heparin. During initial design tests on animals the researchers have found that the unit works as expected. They are now tweaking the instrument to be efficient, sturdy, and practical enough for clinical use, although Langer is uncertain about when it will be ready.

The device could also have other applications. By substituting other enzymes for heparinase, for example, doctors might someday employ the instrument to remove toxins from blood. Langer has studied how an enzyme immobilized by substances in the instrument can alter low-density lipoproteins (LDLs), the harmful form of blood cholesterol that can lead to heart disease, and speed their removal from the blood. (So far, this enzyme can't be safely injected into the bloodstream.) W.R. Grace & Co.'s Grace Biomedical Group of Lexington, Mass., which has helped sponsor Langer's work on LDL removal, has an option to license the device, says Claudy Mullon, manager of biomedical research at Grace and a former postdoctoral fellow in Langer's lab.

MIT researchers are also trying to improve the stability and effectiveness of heparinase and increase its production levels. Ram Sasisekharan, a medical scientist, is overseeing a group that over the past six years has been using polymerase chain reaction technology, which greatly multiplies particular genes so they can be separated from a battery of other genes in solution, to come up with more than two dozen mutant forms of the enzyme with slightly varying attributes. Sasisekharan is also working on producing larger batches of heparinase by scaling up the apparatus used to make the compound.

Improved production levels of heparinase could also be critical if another research avenue someday proves to have therapeutic value. During the course of its work, the MIT team has found that heparin occurs naturally around the out-

side of tissue cells, where it can bind to certain chemical products critical to cell growth, facilitating new blood-vessel formation. This process becomes very active during the course of about 20 diseases, including the development of solid tumors such as those found in many cancers. In 1994 the researchers published findings that heparinase dramatically inhibits new blood-vessel formation. Over the next several years, the group will investigate whether heparinase can halt blood-vessel formation in the eyes of animals, for potential use as a treatment for retinopathy, an eye condition that can cause blindness. An important part of that effort will be studies on ways to efficiently deliver the enzyme to the sites of blood-vessel formation.

—COLLEEN M. SAUBER



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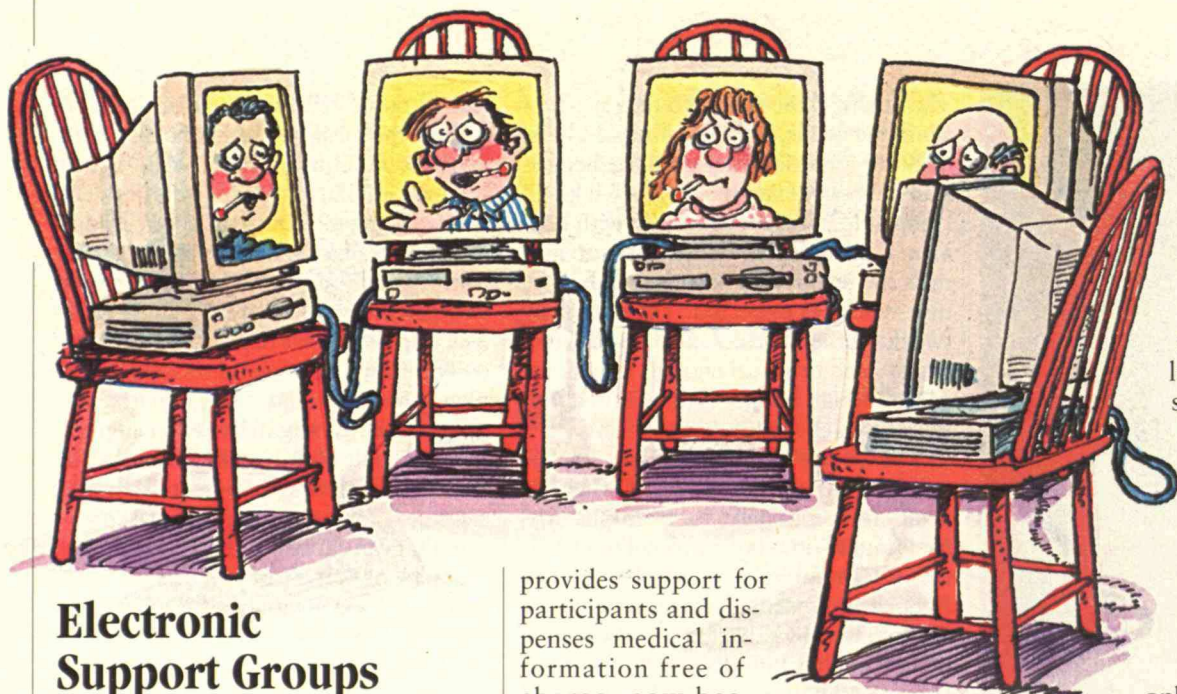
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Trends



Electronic Support Groups

After doctors excised a cyst from her brain five years ago, Samantha Scolamiero sought out a support group. She hoped to talk with other brain-tumor patients about problems ranging from the physical (how best to cope with fatigue) to the financial (whether to try to remain working or collect Social Security insurance benefits). But she had trouble finding an appropriate organization: she didn't qualify for a Boston-based brain-cancer support group that met near her home because her tumor was benign, and she couldn't regularly attend the meetings of a support group up the coast in Salem because she couldn't drive.

Scolamiero's colleagues at MIT encouraged her to join a virtual support group on the Internet instead. From her university computer account, Scolamiero scanned through a list of thousands of support groups, mailing lists, and newsgroups, hundreds of them devoted to health and medical topics. She didn't find any discussion of brain tumors. But she was inspired to create an online group of her own.

"When I started BRAINTMR," Scolamiero says, "it was like climbing to the top of the Prudential Tower and yelling, 'Does anybody out there have an epidermoid cyst?'" Her group, which

provides support for participants and dispenses medical information free of charge, now has more than 500 members. Most participants are patients and family members, but some are researchers and doctors who gain valuable insight into how people cope with serious illness.

As costs for computers, modems, and online services drop, many others like Scolamiero are venturing into cyberspace in search of advice, emotional support, and information about their illnesses. At last count, there were 75 health-related newsgroups on the Internet alone, covering a spectrum of topics. "If you're struck by lightning, there's a self-help group for you," says Edward Madera, director of the American Self-Help Clearinghouse at the Northwest Covenant Medical Center in Denville, N.J., which tracks and helps establish support groups.

Online groups offer their members some obvious advantages over standard face-to-face meetings. Some of the information available online would be difficult for laypeople to obtain elsewhere, such as announcements of the latest clinical trials posted by researchers looking for subjects. Cyberspace is easy to get to even from a hospital bed, if one is equipped with a computer and modem. Communicating in writing is often less intimidating than speaking in

front of a group. And the anonymous flavor of online communication allows introverts to listen in on discussions without feeling social pressure to join in. "You can lurk for six months," says Scolamiero. "You couldn't go to a support group and not speak for that long; it would make people too uncomfortable."

In a study of breast-cancer patients using an online medical network, a team led by David Gus-

tafson, a professor of preventive medicine at the University of Wisconsin, reported that patients preferred the computer discussion group over face-to-face support groups. The patients cited reasons such as "It's there when you need it," "It's easier for a shy person," and "You don't have to look at the faces of dying people."

Online groups might even help reduce health care costs. In another study conducted by the Wisconsin researchers, HIV-infected patients who participated on a similar online system had shorter hospital stays than those who didn't. The researchers hypothesized that patients who used the network, which featured a patient-discussion group, an ask-an-expert service, and a library of educational materials, were better able to recognize their health problems and seek help at an earlier stage.

Still, cyberspace has its own set of problems. On the Internet and the major online services, virtually none of the material is checked for errors. As a result, patients looking for reliable information have to pick their way through ineffective though mostly harmless folk remedies as well as the recommendations of quacks peddling sometimes dangerous wares. One poster suggested snacking on raisins

soaked in gin to alleviate arthritis. Another advocated taking vitamins A, C, E, and B13 (there is no such compound) to halt multiple sclerosis. A World Wide Web home page instructs AIDS and cancer patients to inject themselves with hydrogen peroxide.

John Renner, a researcher at the Consumer Health Information Research Institute (CHIRI), a medical education and antifraud group in Independence, Mo., warns that patients facing life-threatening illnesses are especially vulnerable to outlandish medical advice. "People get desperate. They're not rational. They want to believe one of these crazy schemes will cure them," he says. "I'm fascinated by how parents will ask someone they don't know for health advice for their children."

Of course, people advocate fishy medical remedies off the net as well. What makes the Internet different is the difficulty in verifying where a message has originated. Twelve-year-old pranksters can sign their messages with "M.D." after their names. Glowing testimonials to the effects of new drugs may appear to come from patients, but in reality come from pharmaceutical company employees concealing their affiliation.

CHIRI has considered issuing a rating of the top 10 online medical sites and the worst 10. But Renner acknowledges that this kind of rating system would have limited results, since it could cover only a small portion of the system. Moreover, with new information posted every minute, it wouldn't take long for ratings to become obsolete.

For her part, Scolamiero has considered initiating a registration procedure for BRAINTMR so she could identify who was posting information. It would be "a worthwhile endeavor," she says, but she has neither the time nor money required for the task.

The Internet newsgroup alt.support.cancer likewise recently debated whether to moderate the group after several postings advocated a watermelon juice diet as a cure for cancer. No one seemed taken in by the advice, but the message

sidetracked the discussion as numerous people wrote in to complain about the post and many more responded. The suggestion to moderate was eventually dropped—in part because no one volunteered for the job.

Perhaps the biggest problem with overseeing online content is that individuals and organizations that try to do so may, ironically, end up assuming more liability for misinformation than if they do nothing at all. That's the conclusion legal experts have drawn from the recent libel case against Prodigy, one of the largest online service providers. A New York judge ruled that Prodigy was responsible for an anonymous message disparaging a financial firm and its president, since the online service had claimed to screen messages for offensive material. The court reasoned that Prodigy could not legitimately claim to be a passive distributor of information when it monitored messages. "Anyone who is exercising editorial control is going to be held to a higher standard," says Shari Steele, director of legal services at the Electronic Frontier Foundation. "If you take it upon yourself to monitor, then you have a responsibility to make sure your monitoring is thorough."

In the end, advocates of the system say that for now the Net is able to self-correct. Scolamiero tells the story of a doctor who made a typo in a message he sent to her mailing list about a drug and its recommended dosages. Before he had time to revise the advice, three other people posted messages questioning his suggested medication levels. Echoing that sentiment is Tom Ferguson, a senior associate at Harvard University's Center for Clinical Computing and author of *Health Online*, a guide to online medical information. For every inaccurate statement posted on a newsgroup, he says, there will almost always be someone who notices the error and posts a correction.—LIZ LEMPERT

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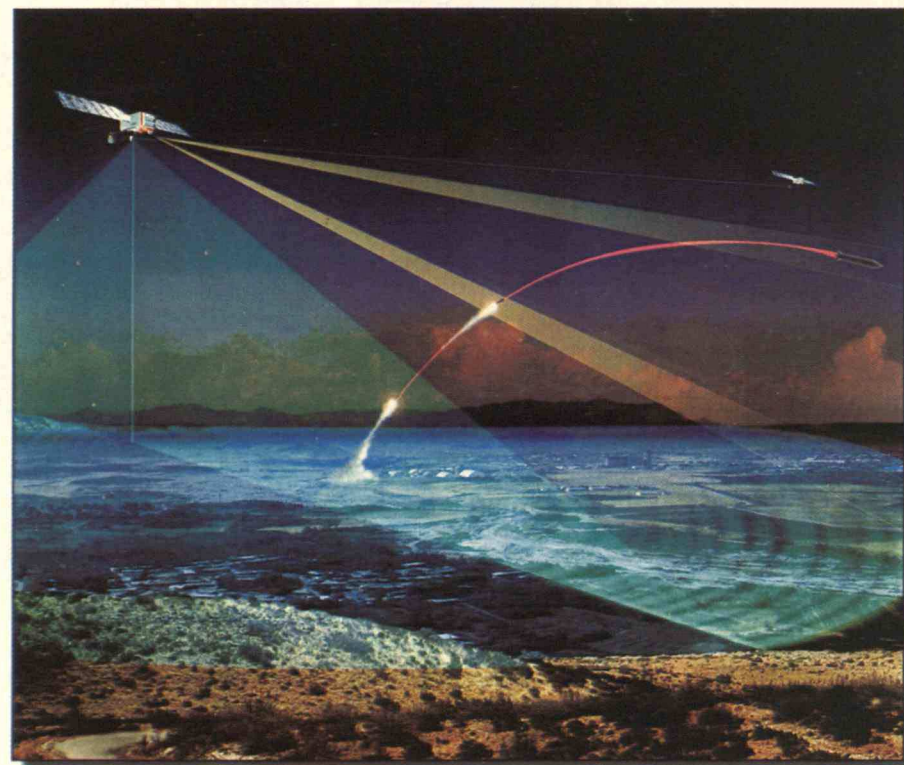
New Eyes in Space

Another effect of the end of the Cold War is the Pentagon's plan to replace the supersecret satellites—part of its Defense Support Program (DSP)—designed to watch for the launch of Soviet nuclear missiles. The new generation of satellites will simultaneously accomplish two key Pentagon goals: detect short-range enemy missiles such as Iraqi Scuds more effectively, and do so less expensively.

The U.S. Air Force operates at least three DSP satellites at all times. Each is stationed 22,000 miles above the equator in a geostationary orbit, in which the satellite moves around the earth at exactly the same speed that the earth turns on its axis, effectively remaining parked over the same spot. The satellites use infrared sensors to continuously monitor the surface. If a missile takes off, the trail of hot gases registers, and the satellite radios a signal to human controllers at the Air Force missile-tracking station at Cheyenne Mountain in Colorado Springs, Colo.

Though originally intended to warn of a Soviet nuclear attack, the DSP satellites were used during the Persian Gulf War to track Iraqi Scud missiles. When the Colorado tracking station received a signal, which included data about a rocket's trajectory, computers calculated where the missile would land and relayed the information to the battle site. Civilians were then able to take shelter, and U.S. troops could try to shoot down the Scud with Patriot antimissile weapons.

As effective as the military claims this detection process proved, Pentagon officials worry that newer short-range missiles with even smaller rockets might be more difficult to detect, and U.S. military planners who think the use of such weapons will become the rule in future wars have been clamoring for a new system. In response, the Air Force announced in February that it intends to build the \$3.8 billion Space-Based Infrared System (SBIRS), a larger complement of satellites with more sensitive infrared sensors placed in a wider variety



of orbits to better locate and track smaller, fainter tactical missiles as well as look for long-range nuclear missiles.

The plan calls for the Air Force to put four new satellites into high geostationary orbits above the equator. To obtain a better view of polar regions and provide additional monitoring of countries in northern latitudes, the plan also proposes to place two additional satellites into unusual elliptical orbits. These satellites would zoom low over the Southern Hemisphere and then climb thousands of miles above the Northern Hemisphere, giving the satellites lots of time to monitor possible launches of long-range missiles from northern nations. For years the Soviet Union—and now Russia—have used this type of orbit, known as a Molniya orbit, to allow communications satellites to broadcast to the country's northernmost regions.

The Air Force also wants to launch a third set of satellites that would orbit lower to the earth. Because of their closer proximity to heat from potential rockets, the infrared sensors would not

The Air Force's proposed missile-detection system includes low-orbit, infrared-sensing satellites that can track the launch of a short-range weapon, such as an Iraqi Scud, as well as the heat from the missile after its rocket is spent.

only be able to more easily detect an enemy missile, but also more accurately track its trajectory. The satellites would also have the capability to relay that information directly to computers at the U.S. antimissile weapon site in the region. This would eliminate the intermediate step of sending the data to the Colorado tracking station—where an operator would look at the satellite readout and then decide whether to send an alert to whomever may be under attack—and thus give those on the scene additional seconds or even minutes in which to react.

Weapons available to combat enemy missiles include the short-range Patriot and the Army's faster, longer-range, and more accurate THADD (Theater High Altitude Area Defense), designed to

intercept missiles closer to the source and thus cut the chances that debris will fall on cities or friendly troops.

The Air Force plans to test the first low-orbit satellite in 1999 and begin launching the remaining undetermined number in that series by 2006. Because these satellites orbit lower to the earth their field of view will be limited. Thus, the total number of satellites in the series will be determined partly by the density of coverage required. Meanwhile, the higher-altitude satellites, which will provide a wider field of view, would be fielded starting in 2002.

Star Wars Spinoff

Both the Army and the Navy, worried that their troops might find themselves under missile attack in a future war, are also lobbying for SBIRS so they can broadcast warnings directly to the danger zone. Today's ship radar systems, for example, can't see far enough to know when the enemy has launched a missile. According to John Springer, a technical adviser at the Naval Space Command in Dahlgren, Va., a SBIRS satellite sitting far above the fray would detect the missile launch and would relay information directly to the cruiser, which could then activate its radar and fire a defensive missile at the target.

Air Force officials, meanwhile, say they will be able to make all this possible while saving money. In fact, they have designated SBIRS as a showcase for procuring weapons. For example, in its instructions to defense contractors interested in bidding on the SBIRS program, the Air Force describes what it wants the satellite to do but not specifically how the satellite must do it. That could enable contractors to adapt satellites already used commercially for communications rather than build an entirely new unit from scratch.

The Air Force is also cutting its own bureaucracy. For a program like SBIRS, the service would normally create a stack of documents four feet tall describing how it plans to oversee its contractors, says Lt. Col. Robert Fisher. But he

and his colleagues have boiled such plans down to a 36-page document. "We've eliminated redundancy and information that doesn't positively contribute to the program," he says.

Still, critics profess plenty of skepticism about the plan, pointing to the fact that the military has been laboring mightily for years to develop a successor to DSP. In the early 1980s, the Air Force proposed the Advanced Warning System, a series of high-orbit missile-tracking satellites that would have more sensitive infrared sensors and an on-board computer to process some of the sensor's readings before ground workers looked at them. AWS was eventually folded into President Reagan's Strategic Defense Initiative, which would also include so-called Brilliant Eyes technology, a complement of low-orbiting satellites that the proposed SBIRS satellites are based on. Thus, the satellite program has come full circle as it now is essentially being spun off from the SDI office and sent back to the Air Force.

In all, billions of dollars and more than a decade have been consumed examining options and drafting plans for DSP's successor—with little to show for it, says John Pike, a space policy analyst at the Federation of American Scientists in Washington. He worries that the military is using SBIRS as a back door to once again begin developing a comprehensive, antimissile defense system for the continental United States. The current DSP satellites are perfectly capable of detecting Scud missiles in flight, he says. "If it ain't broke, don't fix it. DSP worked quite adequately in Desert Storm."

But the Air Force now is facing an inexorable fact of life: since the 1970s, 17 DSP satellites have been launched, and only 6 are left on the ground. The Air Force predicts they will last until 2003. Pike says they may last longer. But sooner or later, the well will run dry. "If there's nothing ready by the early 2000s," says Jeffrey Richelson, a private intelligence analyst, "then there definitely will be a problem."

—VINCENT KIERNAN

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The Perfect Sweetener?

For a truly sweet deal, consider stevia. The pale green leaves of the plant native to Paraguay produce a taste 300 times sweeter than ordinary table sugar. Yet even though stevia's sugary chemicals trigger the same taste buds in the mouth that sugar does, they pass through the body's digestive process without chemically breaking down, making stevia safe for diabetics and calorie-free for people watching their weight.

Moreover, unlike NutraSweet's popular low-calorie sweetener, known generically as aspartame, stevia doesn't break down during baking and has a virtually unlimited shelf life when dissolved in solutions such as soda pop. Finally, the chemicals that make up stevia could be perceived as more natural than aspartame, whose individual components occur naturally, but when combined do not.

The virtues of an "all natural," non-fattening sweetener have already made refined stevia a commercial force in Japan, where 2,000 tons are sold annually, accounting for about 5.6 percent of that country's sweetener market. Perhaps more significant from future commercial perspectives, recent research in Canada suggests that stevia thrives in North America—for instance, in areas where tobacco is grown. Moreover, the post-refining residue of stevia plants has a protein level about the same as alfalfa and thus might find use as a fertilizer or food supplement.

But there is a down side to this South American wonder plant. While it is phenomenally sweet, the four main

sugary chemicals (glycosides) in stevia leave a bitter, metallic aftertaste. Moreover, refiners now use organic solvents such as methyl alcohol (wood alcohol) to separate the glycosides from the leaf. These chemicals do not remain in the refined stevia, but their use prevents manufacturers from claiming that the

an intensive plant-breeding operation occurring at Agriculture Canada's Delhi Research Station about 100 miles west of Toronto. Since 1990 scientists there have been manipulating the quantities of the glycosides in the plant to produce hybrid stevia whose taste is less acrid than crops presently grown in China for the Japanese market. In particular, they have been working to maximize the amount of stevioside, the main sweetener, by repeatedly crossing plants whose leaves have high stevioside contents.

At first agronomists had difficulty transferring pollen between the plants' small flowers by hand, the usual way to produce significant quantities of hybrid seeds. Then the Agriculture Canada scientists had a bright idea. Why not use nature's method of pollinating the plant? "We brought in bumble bees and they worked like a charm," says James Brandle, Agriculture Canada's chief stevia researcher. The bees were released in an enclosed area where plants to be cross-pollinated were kept. The result has been bumper crops of hybrid seeds whose leaves produce a smoother taste.

Stevia normally grows in highlands of northeastern Paraguay, where temperatures can range from about 20 to 110° F during the course of the year and average 70° F. But the meter-high plants also flourish in southern Ontario, which has a climate similar to the mid-Atlantic states. In fact, the Canadian region produces crops such as tobacco, peaches, and cherries, which are normally associated with more southern locales. Thus the plant could be suitable for cultivation in many parts of the world.

The plants have also proven resistant to insects. In fact, other research suggests



The leaves of the hardy stevia plant produce an all-natural refined powder that is 300 times sweeter than sugar but completely calorie-free. And unlike NutraSweet's low-calorie sweetener, stevia doesn't break down during baking.

final product has been processed naturally, a factor consumers traditionally find appealing.

But these concerns may soon fade as collaborative research in Canada and the United States seeks to produce a pure-tasting sweetener that is refined by non-chemical means. One part of this effort is

that Stevia's sweetness evolved as a defense against predators such as aphids, which are repelled by the strong taste of the leaves.

Agriculture Canada researchers are now embarked on a three-year test to see how the plants fare not only in southern Ontario but in other parts of the country. Initial results are promising. Not only did the plants flourish, but their leaves reached their maximum sweetness before frosts hit.

Chemical-Free Processing

At the same time, researchers at the provincially owned Alberta Research Council (ARC) in Edmonton are developing a pilot refinery that will use a stevia refining process first developed by two Calgary scientists. It extracts stevioside through a water filtration process that does not rely on any chemical additives. While the exact procedure is secret, James Laidler, a chemist at ARC, describes the general thrust of the technique. "It is like making the crystals used in instant ice-tea; you just bring the leaves down to a powder." More specifically, the researchers steep the leaves, then pass the resultant liquid through a series of filters that absorb unwanted chemicals. The water evaporates from the refined liquid, and a white powder remains.

The process is being marketed by Royal-Sweet International Technologies of Vancouver, B.C. The company aims to produce 30 tons of sweetener from leaves (the equivalent of 9,000 tons of sugar) as well as re-refine 200 tons of the crude Chinese-made stevioside sweeteners (the equivalent of 60,000 tons of sugar). Royal-Sweet has also entered into an agreement with the NutraSweet Co.'s technology development arm, which is providing taste evaluations, product analyses, and assessments of world markets.

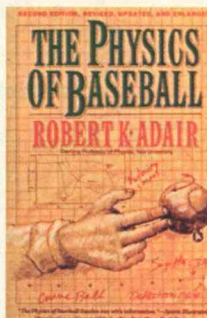
The NutraSweet tests show that cross-bred stevia refined by the new filtration process has no metallic taste and produces no harmful side-effects in humans. Moreover, the glycosides in the refined

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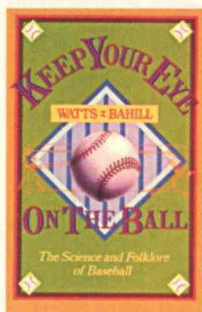
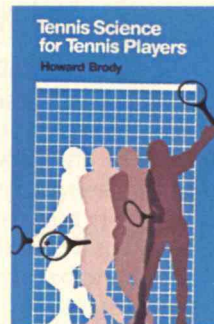
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stevia also blend with other artificial sweeteners.

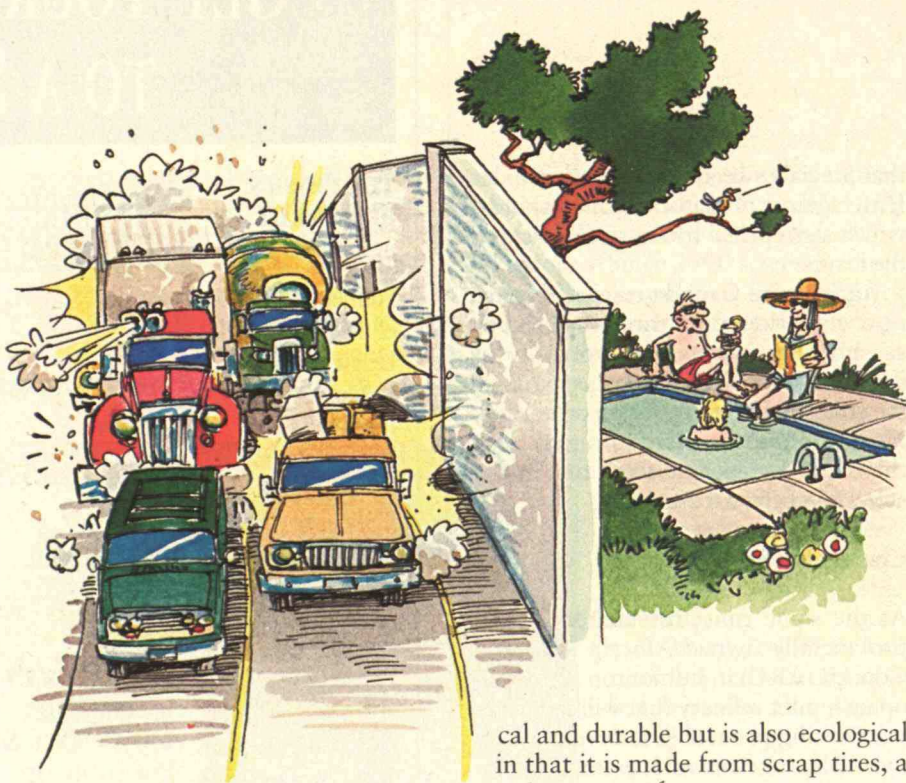
Still, some stumbling blocks must be surmounted before smooth-as-sugar stevioside appears on your grocer's shelves. Because so little stevia need be used to produce the same taste as sugar, researchers are now trying to devise a way to compensate for the bulk factor that sugar adds in baking.

But perhaps the biggest pitfall yet to be overcome is government regulation. The refined stevia, which is a white crystalline substance like sugar, is not now approved for Canadian or U.S. consumption because of the chemicals used in its traditional refining process. Royal-Sweet is trying to get the non-metallic-tasting stevia refined by its water-filtration process approved for sale by Health and Welfare Canada. It will then seek permission from the Food and Drug Administration to sell refined stevia in the United States.

William Barratt, the company's chief operating officer, believes it will take about three years for FDA approval (because of the immense amount of paperwork involved), even though the leaves have been used for centuries by Indians in Paraguay to sweeten herbal tea, and chemically refined stevia is in general use in China, Russia, Korea, Japan, Israel, and Brazil. Furthermore, Japanese toxicological tests on the chemically refined stevioside show no adverse effects. On the contrary, one study in rats found that it actually lowered blood pressure.

While it waits for certification in North America, Royal-Sweet has contracted with China to build a plant to refine stevia there. Meanwhile, because they are a natural product, stevia leaves imported from Paraguay or China can be sold in health-food stores in many parts of the world including Canada, but not the United States. But as Evelyn Dorfman, an owner of a Toronto natural food outlet points out, not only do people dislike the metallic taste of the unrefined leaves, "they don't like putting something green in their coffee."

—STEPHEN STRAUSS



Making the Sound Barrier

Two wrongs never make a right, but sometimes they can cancel each other out. Such is the case with two undesirable byproducts of our automobile-based transportation system: highway noise and discarded tires. In a growing number of municipalities across the nation residents are opting for noise barriers made of scrap rubber to protect homes and offices near highways from the obnoxious roar of the road.

Interest in blocking road noise has been growing in the past couple of decades as highways and homes have been built in closer proximity to one another and as roads have become more heavily traveled. In fact, whereas less than one mile of barriers was constructed to block road noise in 1970, today about 100 miles of barriers are built each year.

Conventional noise barriers take a variety of forms, including concrete, masonry, metal, stucco, wood, or some combination of materials. Now Carsonite International, a small company in Carson City, Nev., says it has developed a noise barrier that is not only economi-

cal and durable but is also ecological in that it is made from scrap tires, a major source of waste.

More than 2 billion used tires have already been stockpiled in the United States. And of the additional 285 million tires discarded each year, only about 100 million are reused or recycled, leaving the remaining 185 million tires for landfills, stockpiles, or illegal dumps. Besides being an eyesore, these mounds of tires pose a threat of fires that can pollute the air and release oil to nearby groundwater or serve as homes for mosquitoes and rodents.

Seeing an opportunity to fill a growing demand for noise barriers with this abundant and otherwise unusable surplus, Carsonite designed a hollow fiberglass wall supported by concrete or steel beams and filled it with rubber crumbs—ground from scrap tires to less than half an inch in diameter—which they purchase from scrap rubber companies. On average, one mile of wall, which ranges from 10 to 28 feet in height, requires a post every 8 to 10 feet to support the panels of tongue-and-groove fiberglass planks and incorporates the crumbled rubber from about 20,000 scrap tires.

Paul Schubring of Carsonite says that its sound barrier usually costs from \$15 to \$17 per square foot, which according to the U.S. Department of Transportation is about the average cost of all types of

wall barriers. Still, Paul Wilcox, an engineer in Nevada's Department of Transportation who is installing 3,200 feet of a 14-foot-high Carsonite barrier along an elevated state highway, estimates that in some applications the scrap-tire barrier could cost as little as \$12 per square foot.

Effective Blocking

Wilcox also points out that the scrap-tire barrier—which is projected to last about 50 years, about the life of a concrete sound barrier—will save money in the long run because it is easier to maintain and repair, a major consideration since the barriers “get hit quite often.” For example, he says, while it usually takes three workers a couple of days to repair a small section of a concrete barrier, one worker can replace a section of the interchangeable rubber-filled panels in less than half a day.

In a test of the barrier's noise-blocking ability, Riverbank Acoustical Laboratories in Geneva, Ill., directed sounds of various volumes and frequencies to one side of the wall. A microphone on the other side registered reductions of 24 to 42 decibels—a range that far exceeds noise-control requirements for sound barriers in most state transportation departments.

Because decibels are based on a logarithmic scale, a transmission loss of 10 decibels means that the sound's volume decreased by half and a loss of 20 decibels means the sound decreased to one-quarter of its original volume. Thus the wall cut sound transmission to less than one-fourth of its original volume in the worst case and to less than one-sixteenth in the best case. This range offers excellent noise reduction, since cutting noise to half of its original volume is considered good for most sound barriers.

Carsonite reports that it has installed more than 100,000 square feet of its barriers along more than 5 miles of highways in California, Illinois, Nevada, Oregon, and Virginia. Over the next few months, the company expects to triple that figure and install barriers in a dozen other states.—MIKE MAY

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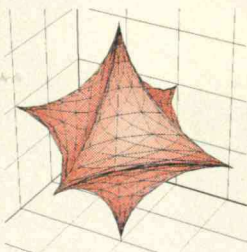
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Maintaining Diversity in the Electronic Republic

BY LAWRENCE K. GROSSMAN

A NEW political system is taking shape in the United States. The convergence of television and radio, computers, satellite technology, and telephony is turning the country into an electronic republic, combining elements of direct democracy with our traditional representative government. As interactive telecommunications drastically shrink the distance between the governed and those who govern, many more citizens are gaining a greater voice in making day-to-day public policy than the nation's founders intended.

More than 30 years ago, in *Understanding Media*, media guru Marshall McLuhan foresaw that trend: "As the speed of information increases," he wrote, "the tendency is for politics to move away from representation ... toward immediate involvement of the entire community in the central acts of decision."

McLuhan was on target. Each year millions more citizens acquire personal computers, link up with computer networks, and

communicate their ideas to their elected local, state, and federal officials as well as to one another. Internet users can send messages directly to the White House. And, of course, in ever greater numbers citizens are paying for older

technologies such as cable and satellite television, which, along with traditional broadcast TV and radio outlets, transmit programs that provoke viewers to bombard Congress with opinions on controversial issues. This trend will grow in the next few years as digital TV permits the broadcast of five or six channels on frequencies that today can send only one. Faxes, telephones, and computers enable citizens to participate directly in call-in talk shows, reply to incessant public-opinion polling, and offer constant feedback to government officials with a speed and frequency heretofore possible only in the tiny ancient Greek city-states and in old-fashioned New England town meetings.

To paraphrase another statement of McLuhan's—"Guten-



*telecommunications
technologies change with
astonishing speed and
media companies race
headlong into mega-deals,
the government needs to
ensure public access to the
wide range of information
essential for participatory
cyberdemocracy.*

ILLUSTRATIONS BY LIZ MURPHY

berg made everybody a reader. Xerox made everybody a publisher"—today interactive telecommunications make everybody a lobbyist.

Quality Programming Won't Fill Cyberspace

In this electronic republic, the need for Americans to be well informed and educated about complex issues and the workings of our political system has become more important than ever. But the lamentable performance of the mainstream electronic media that have been around for decades offers little grounds for confidence about the future. Current trends give no evidence that quality programming, as well as other communication formats that include responsible information on civic affairs, will automatically appear to fill the expanding cyberspace. Under the present, commercially driven system, such programming has become the rare exception rather than the rule. The big push is to exploit what Michael D. Eisner, chair of the Walt Disney Co., calls the world's fast-expanding appetite for "nonpolitical entertainment and sports." That, he has explained, is what makes Disney's announced acquisition this past summer of Capital Cities/ABC so appealing.

There is another concern as well. Much of what Americans, and increasingly the rest of the world, see and hear is coming under the control of a shrinking number of huge global media companies, as titans such as Disney, Time Warner, Viacom/Paramount, and Rupert Murdoch's News Corp. pursue further mergers, acquisitions, and consolidations. And that trend could stifle media competition and the diversity of ideas. Some of the biggest and most influential players—for example, General Electric, which owns NBC—are not primarily in the business of serving the public through quality journalism.

I worked for GE between 1986 and 1988 (during my last two years as president of NBC News). At one of our first management meetings after the company bought NBC's parent company RCA, John Welch, chairman of GE, asked why NBC News did not boost its revenue by charging authors, book publishers, and movie companies for the interviews and feature time they received on the *Today* show and other news programs. His suggestion that editorial exposure on television be sold like a commodity is comparable to urging newspapers and news magazines to sell their editorial space to anyone willing to pay the price. In the end, citing NBC News's



long-standing journalistic standards precluding such a practice, we emphatically rejected Welch's suggestion. But the incident was revealing: large companies with no history in the traditions of journalism are prone to rank financial demands above the public interest.

Legislation radically deregulating telecommunications, passed by Congress this past summer, promises to further reduce the number of major media players. It will repeal long-standing prohibitions against ownership by one company, in one area, of the local newspaper and TV and radio stations, and by lifting ceilings on the number of radio and television stations a single company can own. Broadcasters will be allowed to own cable systems—and vice versa. Telephone companies will be able to own cable systems in the regions they already serve.

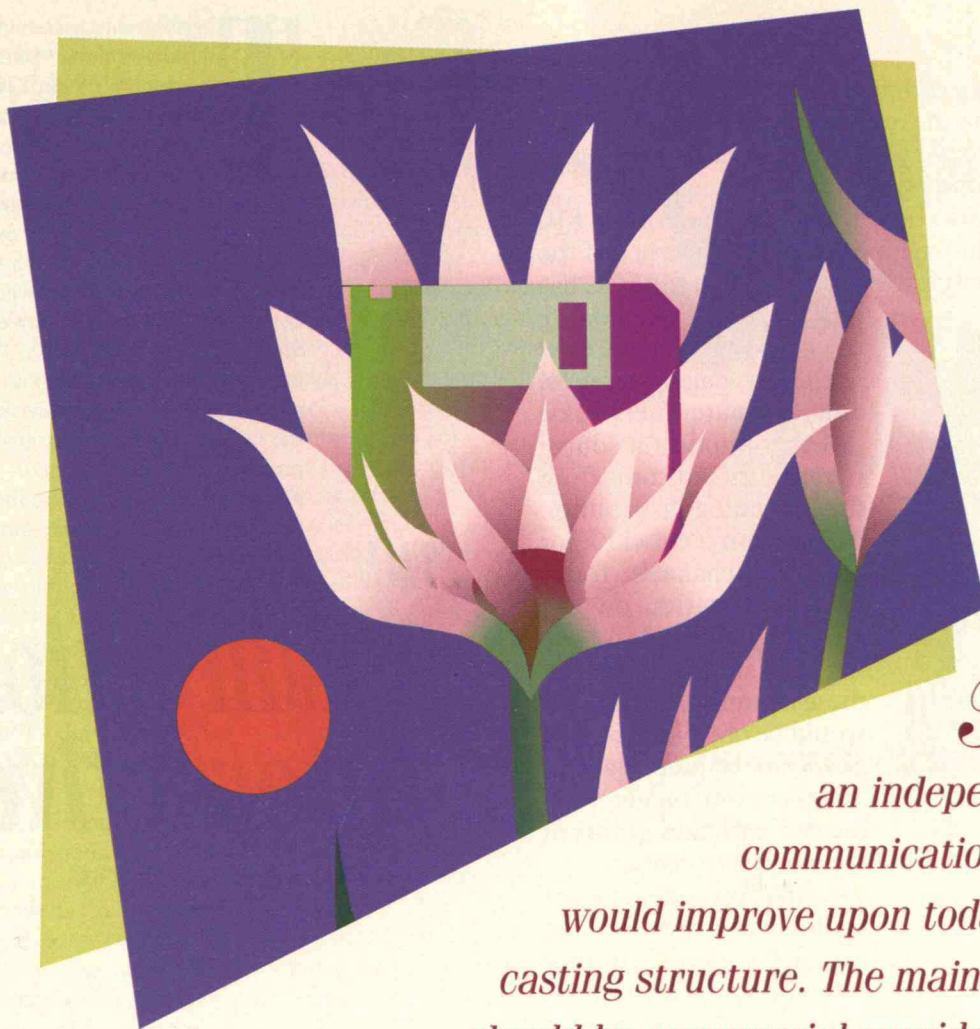
A major overhaul of government policies *did* become essential as telecommunications technologies changed drastically. For instance, regulatory restrictions based on channel scarcity no longer made sense. But the current legislation encourages the big and powerful telecommunications conglomerates to grow even bigger and more powerful. Thus the diversity of information and ideas available to the public will be diminished.

How to Provide Needed Services

So what can be done to fill the gap in public-interest information? The nation needs an independent public telecommunications trust fund, overseen by an outside board of directors, that would supersede and greatly improve upon today's anemic, seriously threatened public broadcasting structure.

A large part of the trust fund's mission would be to help pay for a wide variety of vehicles to disseminate essential civic information through the public sphere. The existing organization of public television and radio stations, which can reach virtually every resident in almost every community with both local and national programming, is a good foundation upon which to build. For instance, ample free "time" (to use the terminology of TV and radio) should be opened to candidates for public office, as well as to political parties, labor unions, civic associations, community-action groups, public-interest groups, and citizens' organizations. The new public telecommunications system should provide programs and the computerized equivalent for open discussion of key issues, and for national and local electronic town meetings, community forums, and other forms of citizen feedback. The trust fund could support the Library of Congress, among other fair-minded, authoritative sources, in producing CD-ROMs and other software to provide the public with background reports, fact sheets, and the like on major civic issues.

LAWRENCE K. GROSSMAN, formerly the president of the Public Broadcasting Service and of NBC News, is the president of the forthcoming PBS Horizons Cable Network, which will carry cultural and informational events from universities, museums, libraries, and cultural and scientific centers in the United States. This article is adapted by arrangement with Penguin Books USA, Inc., from *The Electronic Republic*, by Lawrence K. Grossman (copyright © Lawrence K. Grossman, August 1995).



*The nation needs
an independent public telecommunications trust fund that
would improve upon today's public broadcasting structure. The main source of funding
should be commercial providers in the industry.*

At the very least, the trust fund should pay to activate the local public-access cable channels that federal law requires every major cable franchise to reserve for public, educational, and government use. These channels, which could bring classrooms and town meetings into the home, operate in less than 15 percent of the nation's cable systems today because the money for them simply has not been made available.

How can any of this be realistic at the very time Congress is slashing federal budgets for public broadcasting and public education? Fortunately, major new funding sources are available. Some seed money—for both local and national efforts—could continue to come from voluntary contributions from individuals and corporate and foundation sources. But the main source of funding for the electronic republic's citizen information and education needs should be commercial providers in the emerging telecommunications industry: the broadcasters, cable and satellite operators, and telephone companies that are reaping growing dividends from their exclusive use of *publicly owned* frequencies. The time is long overdue for com-

mercial broadcasters and other telecommunications providers to pay reasonable fees for access to such valuable public property.

The federal government has long grappled with the public-private interplay in the telecommunications business. More than 60 years ago the Federal Radio Commission ruled that broadcast stations were "licensed to serve the public and not for the purpose of furthering the private or selfish interests of individuals or groups of individuals." More recently, in 1984, Congress required cable operators, in exchange for their monopoly franchises in communities, to pay a small percentage of their revenues to local governments. (But instead of going to support public-access channels, as originally intended, the cable-franchise fees have had a way of disappearing into the municipalities' general funds.)

Congress should require spectrum users to pay a small amount—from 1 to 2 percent of their annual revenues—to support the public telecommunications trust fund. Additional funding should come from a small tax on the sale of station licenses, cable franchises, satellite and cellular-phone companies, and paging services.

Most of the value of today's communication mega-mergers and acquisitions lies precisely in the exclusive license and franchises originally granted free of charge by the Federal Communications Commission (FCC) and other government agencies.

The trust fund should also reap a small fraction of the \$10 billion government windfall from the 10-year licenses of the remaining electromagnetic spectrum space, which the FCC has

finally begun auctioning to companies for wireless telephony, paging services, and computer networks. Another important source of funds should come from the upcoming distribution of spectrum bandwidth for digital-TV channels. Today broadcast station owners are lobbying hard to have the FCC simply hand over these channels, an act that would be one of the biggest government giveaways in history, even bigger than the railroad land grants of the nineteenth century.

Ample precedents exist for imposing such fees and taxes. Ranchers, lumber companies, and offshore oil drillers pay the government for their use of public lands and waters. At least part of this money goes to help mitigate some of the damage caused by commercial use.

Unless Congress arranges for an independent public trust fund to support quality public telecommunications, we shall be left to rely entirely on the commercial

marketplace to determine how much and what kinds of news, educational fare, and other information citizens receive. Those who pay the most will receive the most exposure for their ideas and views, under the self-interested domain of a handful of global media conglomerates. These companies, which are in business to look upon people as consumers rather than as citizens, will not fill the vital civic, educational, and cultural communication needs of the emerging electronic republic. It is time for citizens to speak up for the public interest as Congress and the media giants redraw the telecommunications map in the fast-growing world of cyberspace. ■



*By themselves,
media conglomerates
will not fill the vital
civic, educational, and
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tion needs of the
electronic republic.*

There's a classic scene in the television show "Seinfeld" in which Jerry and George are pitching their idea for a new TV series—a show "about nothing"—to a bigwig network executive. "If the show is about nothing," the executive asks, incredulously, "why would people watch?" George comes back with the definitive answer: "Because it's on TV!" He's expressing the relationship most people have with their television: the reason they watch any given TV program is because it's there—and happens to be preferable to the other stuff showing in the same time slot.

THE Misdirection of Interactive TV

BY EVAN I. SCHWARTZ

The collection of technologies known as interactive television turns that 50-year-old bargain between programmer and viewer on its head. Instead of sitting down on the couch and asking "What's on?" you are now given the challenge, "What do you *want* to be on?" As telephone, cable, computer, and entertainment companies race to build a high-speed, two-way network into the home, they can make movies, reruns, documentaries, games—even financial and shopping services—available "on demand" from a virtually bottomless digital database. In essence, everyone becomes his or her own TV network executive.

Sounds good in theory. But after touring several of the test markets where this new generation of TV is being tried out, I have concluded that this is not going to work—at least not as currently devised. For starters, the companies getting into this business assume that people will want to use interactive television to save time—to pay bills quickly, get financial information,

save trips to the video store, and sift through animated graphics to buy everything from groceries to gifts. But television—unlike the personal computer, which rode into our lives on promises of raised productivity—has a long tradition as a time-wasting device. The average American watches more than four hours of TV per day, according to Nielsen statistics. If people need to save time so much, where did they get these extra hours in the first place?

People watch television first and foremost for entertainment. It stands to reason, then, that the applications that enhance this experience, such as interactive game shows and video action games, have the best chance of succeeding in the new TV market. GTE has learned that lesson the hard way. After ten years of developing and testing education, information, and time-saving features, the telecommunications giant has found that people like its cable-based “main-Street” brand of interactive TV for the games. The GTE customers I visited near Boston are interested in using their remote control to register answers to game shows, compete in trivia games, predict during football season whether the quarterback will pass or run the ball, and participate in events such as voting for their favorite actors on Oscar night. Coming soon: betting fake money on horse races.

The business models of the companies getting into the interactive television business seem based on unrealistic assumptions. Time Warner, with a much hyped test of its Full Service Network in Orlando, and Microsoft, in a test in Seattle, expect that consumers will pay an extra \$50 per month for advanced television services such as customized news programs, movies-on-demand, and educational videos. Not only might customers balk at this figure, but, executives admit, it

still won't be enough for these companies to break even on their investment any time soon.

To increase potential revenue, the cable and phone companies are concentrating their interactive-TV experiments in ultra-high-income communities such as Fairfax County, Va., where Bell Atlantic has been recruiting 1,000 households. But such tests will not necessarily provide good indications of the larger TV-watching public. Television viewership varies inversely with household income: people in households with incomes over \$80,000 report watching about a third as much TV as people in households with incomes under \$20,000, according to Leisure Trends, a Connecticut-based market research firm. In other words, the people who are most interested in TV are the ones with the least disposable cash to spend on these new digital services.

The companies pushing interactive TV are thus counting heavily on advertising to turn a profit. The idea is for central computers in the cable control room to gather demographic and viewing information about subscribers and provide aggregated lists to marketers. Bell Atlantic, for instance, believes people will use their remotes to call up additional information on new products and services that are specifically targeted to those viewers. But such advertising depends on viewers' willingness—not yet demonstrated—to sell off their privacy in return for cheaper programming, by participating in what are essentially direct marketing campaigns.

In what is perhaps the biggest roadblock to the success of interactive TV, each different network uses its own proprietary system. An interactive service or advertisement created for the Bell Atlantic system, for example, won't work on the Time Warner sys-



Commercial services need to be less expensive, less restrictive, and more reflective of what customers actually want.

tem without modifications; the different set-top boxes are not necessarily interchangeable. This crazy-quilt approach presents a potentially fatal problem: unless the operators of interactive TV systems stick to a set of standards, they will have a tough time attracting the huge quantity of content needed to keep customers coming back.

When the marketplace finally forces standards into being, interactive networks will look less like today's notion of television and more like the Internet. Just as thousands of computer users have created their own home pages on the Internet's World Wide Web, consumers with interactive TV could host their own full-motion video channel. People could truly participate in the medium by posting

everything from localized versions of America's Funniest Home Videos to neighborhood crime-watch footage inspired by the Rodney King video. Maybe more people will begin tuning in to what is happening in their own communities rather than on “Melrose Place” or in Seinfeld's ersatz Manhattan.

But until the technology enables this, my message to the companies building the information pipeline of the future is the same reply that the network executive gives to George Costanza after George explains that his new show will garner an audience simply because it's on TV: “Not yet it isn't.”

EVAN I. SCHWARTZ, a former reporter for Business Week, is a Boston-based writer covering science and technology.

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Patent Medicine

BY SETH SHULMAN



*Ill suited to evaluating
the broad claims of biotech and
software firms, the 200-year-old
U.S. Patent Office could use a
dose of reinvention.*

PHOTOS BY L. BARRY HETHERINGTON



Ronald Scott made the pilgrimage from North Carolina to the annual Inventors Expo—sponsored by the U.S. Patent and Trademark Office—carrying U.S. patent number 5,246,793, a hinged plastic case he designed to enclose car batteries and minimize acid spills. Charles Popenoe showed off his patented “Smartbolts,” whose tops change color when they have been completely tightened. Twelve-year-old Akhil Rastogi demonstrated a patented spout he called “E-Z Gallon,” which allows kids to pour a gallon of milk by tipping the container rather than picking it up. Septuagenarian Horace Knowles handed out samples of his recently patented bookmark that lets you know by its orientation exactly where on the page you stopped reading.

Although the atmosphere at the expo falls somewhere between that of a high-school science fair and a late-night segment on the Home Shopping Network, the gathering is intended to showcase an idealized patent system that, by rewarding good ideas, spurs a host of individual inven-

tors to innovate in their fields. In case the connection between a gimmicky bookmark and technological progress should escape the casual visitor, a prominent exhibit in the back corner of the hall canonizes the nation's legendary inventors—Bell, Deere, Dow, Edison, Otis, Goodyear, Westinghouse. Like patron saints, these venerated inventors not only inspire the hopeful but boost an important tenet of American mythology: that entrepreneurial inventors built—and continue to drive—the country's economy. A similar exhibit adorns the Patent Office's sprawling complex in Crystal City, Va.

"When I walk into my office every morning, I see the patent model of Thomas Edison's light-bulb sitting there," Patent Office head Bruce Lehman noted recently. The display, he says, reminds him that "intellectual property protection—patents and copyrights—have been a major part of the economic growth of America from the very beginning."

Historically speaking, Lehman's view is undoubtedly correct. Today, though, a growing number of scientists, business executives, and patent lawyers worry that things have gone awry with the patent system. A parade of sweeping patents in high-tech fields has seemed to expand the office's mission. With the U.S. Supreme Court's blessing, for example, Harvard University researchers have now patented several species of mice. Basic software concepts such as the electronic merging of documents have also won patent protection.

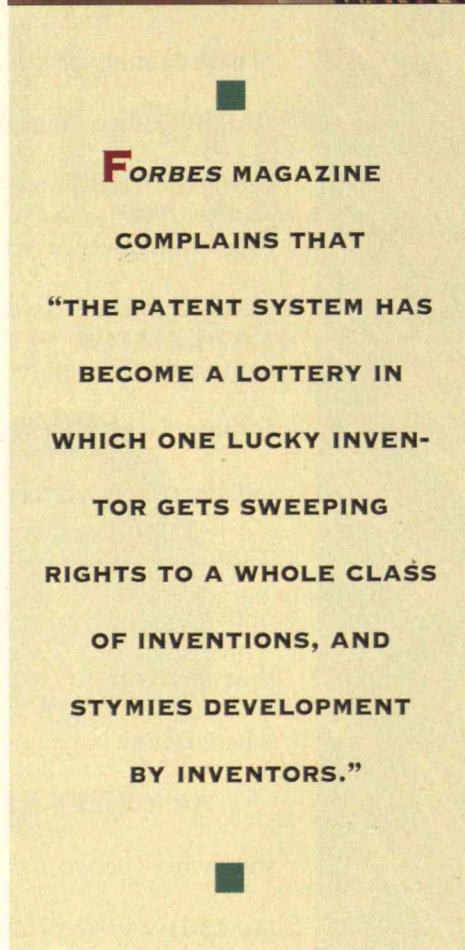
Scientific laws are supposed to be unpatentable, but a California mathematician recently won protection for the use of two large prime numbers as part of a technique to encrypt electronic messages. Richard Stallman, a founding member of the League for Programming Freedom, reported last year that, in an effort to test the system, a colleague succeeded in winning a patent on Kirchhoff's

Law, first expounded in 1845, which holds that the electric current flowing into a junction equals the current flowing out. "If the Patent Office couldn't understand electricity after a century," Stallman griped, "how can we expect it to understand software in another decade or two?"

Stallman contends that, despite the message conveyed by the inventors' expo, the Patent Office is not fostering entrepreneurial innovation. None other than *Forbes* magazine agrees, complaining that, especially in high-tech fields, "the patent system has become a lottery in which one lucky inventor gets sweeping rights to a whole class of inventions, and stymies development by inventors." *The Economist* has similarly charged that broadly construed U.S. patents have failed to reward specific innovations while too often allowing companies to "charge rent on dreams."

Well-publicized reversals by the Patent Office on key claims give these criticisms added credence. Take the notorious case of the patent on all multimedia software, granted to Compton New Media in 1993. Compton's application, which included some 41 separate claims, contended that the firm was the first to develop database software allowing users to search simultaneously for text, graphics, and sound. With scores of multimedia products already on the market at the time the patent was announced, in a field that had seen lengthy and complex development, Compton's claims were widely viewed as preposterous.

Robert Lippincott, president of the Multimedia Industry Association, reportedly dubbed the patent "a 41-count snow job." Within a year the agency had rescinded the patent. By then, however, the case had polarized the software field and raised a vexing question: even if Compton could unequivocally establish that it was the first to develop a multimedia database, should any firm be able to lay claim to such a broad and expanding group of products? Even Timothy Boyle, head of a consortium of software companies that includes Compton, urged patent officials to allow fundamental concepts like multimedia to remain in the pub-



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SETH SHULMAN, a contributing writer for *Technology Review*, has also reported widely for other publications, including *Smithsonian*, the *Atlantic Monthly*, and *Discover*. He is the author of *The Threat at Home: Confronting the Toxic Legacy of the U.S. Military* (Beacon Press, 1992).

lic domain. "How would theater have developed if the concept of 'plot' were owned by someone?" Boyle rhetorically asked. "William Shakespeare never could have afforded a license."

A strikingly similar case occurred when the Patent Office awarded biotech firm Agracetus a patent last year on *all* genetically engineered cotton after the company laid claim to the first successful method for inserting genes into cotton plants. The agency quickly decided to "reexamine" its decision after receiving a voluminous number of complaints and, as in the multimedia case, ultimately rescinded the patent. As Agracetus appeals the decision, questions remain about whether such high-profile reversals are merely isolated blunders. Stephen A. Bent, a Washington-based patent attorney, complained to the *New York Times*, "The only reason these two patents were reexamined was that there was a big public outcry." The real question, Bent says, is what the reversals imply about other patents in emerging high-tech fields.

How does the Patent Office decide what deserves a patent and how broadly such patent protection should be construed?

A Worm's-Eye View

Some answers can be found in a visit to U.S. Patent and Trademark Office headquarters in the concrete landscape of Crystal City, across the Potomac from the nation's capital. Here some 1,800 federal examiners, aided by thousands of support staffers, process and pass judgment on roughly 173,000 patent applications annually. Yet despite its size, age, and pedigree, the agency must surely rank as one of the least-known agencies of the federal government.

At first glance the corridors and suites of the U.S. Patent and Trademark Office resemble those of any modern office complex, but closer scrutiny reveals an institution steeped in the past. Anthoula Ponrening, a mechanical engineering graduate of the Illinois Institute of Technology and an examiner with four and a half years of service at the agency, makes this clear on what she calls a "worm's-eye tour of the patent system." Even the division of labor sounds antiquated. Patent examiners are grouped not into familiar scientific or technological subdisciplines but rather into some 16 broad fields, or "art groups," intended to mirror different types of inventions. Falling within the vast group called the "mechanical arts," Ponrening's specialty—her so-called art unit—is fluid dispensing.

Unless she quits or is promoted, Ponrening explains, "all the applications I will review as an examiner will be for reputedly novel ways to dispense liquid." Much of her work involves minor refinements to the designs of spray nozzles and soda fountain dispensers. Occasionally, though, she receives an application for something altogether new. In 1993, for instance, Ponrening was the



New fields invite the broadest patent claims: here the late Edwin Land points to a likeness produced by a Polaroid camera, which earned him protection for all methods of achieving instant photography. Participants in mature industries must often settle for narrower claims: this Gillette razor alone is based on 17 inventions, the patent numbers for which are listed on the package.



examiner of a patent for the now-popular super squirt guns that can shoot streams of water dozens of feet.

Recent diagrams submitted to her art unit call to mind the patent drawings and models of mechanical gadgets from two centuries ago that adorn many walls at the agency. In a rabbit's warren of a specialized library near her office, the stapled sheaves that compose each patent are stacked chronologically in piles of precisely defined categories within shoe box-size file drawers. Hundreds of rows of these drawers cover aisle after aisle from floor to ceiling. Although the quantity of paper has grown phenomenally, the filing system hasn't changed since its creation by Thomas Jefferson, the nation's first patent administrator.

As Ponrening explains, her job is an iterative process. She ultimately awards patents to some 60 percent of all applicants—the average overall acceptance rate for the Patent Office. But as the agency grants only 10 percent of all applications on their initial appeal, the system entails much give and take between examiners and applicants. Indeed, from the perspective of the shrewd applicant, a patent accepted on the first presentation probably didn't claim enough—as with a house on which someone immediately bids the asking price. Much of the patent attorney's job comes in trying to claim as much as is reasonably possible. In part because of this process, and in part because of the Patent Office's standing backlog, the average application now takes 19 months to work its way through the system.

The sheer scale of the enterprise impresses a visitor. The agency's central library holds a collection of some 23 million documents pertaining to more than 5,450,000 patents. And a tour through the stacks makes clear the extent to which these patents pervade our lives. Before reaching the breakfast table, the average American uses scores of items—from toothbrushes, shampoos, and shower heads to alarm clocks, light fixtures, and slippers—covered by hundreds of U.S. patents. Gillette's latest nonelectric razor, for example, is covered by no fewer than 17 patents, which the company proudly lists on the package.



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Aside from the sheer multitude of patents, an observer is immediately struck by how powerful claims like these can be. Copyright, the other major method for protecting intellectual property, requires users to seek permission to reprint an exact expression, but the authors of copyrighted songs, writings, and other creations are usually happy to see their underlying ideas spread freely. Patents, deputy assistant commissioner Charles Van Horn explains, are distinguished by their unique ability to allow the bearer "the crucial right to exclude others," or to charge for their participation. In an office brimming with stacks of so-called file wrappers—blue folders containing pending applications—Van Horn makes the classic case that without such a right, most companies will simply shun the risk of investing in a new technology. For example, he says, "on average, drug companies now spend \$250 million to bring a drug from conception to approval by the FDA. If not for the patent system, the "public will never benefit from the fruits of that kind of research and many great ideas will never be realized."

Given such stakes, it is little wonder that patent protection can be valuable. Stanford University reports that one basic biotech patent will have earned the school some \$87 million in licensing fees by the time it expires in 1997. Texas Instruments earns close to \$200 million annually—more than half its total annual profits—from such fees.

Broad Patents for Emerging Fields

New, wide-open fields offer particularly big potential rewards for patent applicants. A classic example is

Edwin Land's patent on instant photography, which almost single-handedly ensured Polaroid's success. With no competing claims to be found, Land was able to protect not only his method of achieving instant photography but any other method that might produce similar results. In a well-publicized court battle with Kodak for infringing the patent, the company reaped an award of \$910 million.

But if emerging fields lend themselves to broad

patents, do broad patents stifle competitors in emerging industries? The Agracetus cotton patent offers some cause for concern. In this case the company, a subsidiary of the chemical giant W.R. Grace, pioneered a "gene gun" that inserts genes into cotton and other plant species. Relying on advice from its legal counsel, Agracetus applied for—and initially won—a patent that broadly staked the company's claim to all genetically engineered cotton, no matter the technique used to achieve it. The scope of the patent meant that dozens of publicly and privately funded research teams around the country would have to gain Agracetus's permission to continue their work. If Agracetus were willing to license the work, the research teams would likely have to pay royalties, and any commercial discoveries would be subject to the company's approval before they could be marketed or otherwise disseminated to farmers.

Soon after winning the patent, however, Agracetus stated that it would exercise its right *not* to license its patent for any work that attempted to change cotton's qualities. Dozens of labs faced the prospect of cutting off their cotton experiments entirely, including a good number conducted under the auspices of the Department of Agriculture. "If this patent holds up, it will shut our work down, hinder research into transgenic cotton, and hurt U.S. agriculture," lamented Melvin Oliver, a plant pathologist at the Cotton Systems Research Laboratory in Lubbock, Tex. Within months the department took the unprecedented move of legally contesting the patent, arguing that its researchers, including some at the Lubbock laboratory, had made well-known advances that contributed to the Agracetus technique.

Patent expert John Barton, a professor of law at Stanford University, says Agracetus's claim does have precedent in patents granted in the pharmaceutical and chemical industries, where commonly "the first producer of a new chemical can patent the chemical itself and obtain protection against other inventors who find different ways to produce it." And Robert Merges, a legal scholar and patent specialist at Boston University, points out that people often complained that the Patent Office granted overly broad patents in the early years of the chemical industry. He optimistically maintains that skirmishes over broad patents tend to subside as industries mature, and predicts such a scenario for biotech after an initial shakeout. "A biotechnology start-up firm," he says, "is nothing more than its technology. A lot of money is at stake in its patents as companies vie for position."

But Stanford's Barton notes that in biotech, "analogies are easy to draw between one advance and another," so it is often fundamentally unclear "how far to go in defining" the scope of a patent. For instance, Agracetus has also applied for U.S. patent protection for all genetically engineered soybeans, to complement a similar patent the firm recently won from the European Patent Office. (The European decision has drawn legal

challenges from competitor Monsanto as well as an international coalition of public-interest groups that opposes patents on major food crops.) If indeed Agracetus has pioneered this technology, Barton asks, should the firm receive a patent on its procedure for inserting specific genes into both cotton and soybeans? Or should the company receive a patent covering use of the gene gun on certain crops? Or, as the U.S. Patent Office initially ruled in the cotton case, does the firm deserve a patent on any type of genetic manipulation of a crop by whatever means? Barton says that monopolistic claims such as the one granted on cotton often "seem more strict than is necessary for encouraging innovation," and worries that broad patents will squelch important areas of biotech research. He also points out that unlike techniques for creating traditional chemical and pharmaceutical products, two genetically engineered organisms may produce the same medically useful protein but still remain "genuinely different life-forms," complicating the patent situation.

In another high-profile example of a broad biotech claim, W. French Anderson, a researcher at the National Institutes of Health (NIH), made headlines in 1990 by using gene therapy on a human patient for the first time—specifically, to treat a child with a rare blood disorder. Earlier this year, the U.S. Patent Office granted NIH patent protection for *all* ex vivo gene therapy, which entails removing malfunctioning human cells and genetically altering them before returning them to the patient. NIH has granted an exclusive license to Maryland-based Genetic Therapy, whose scientific advisory board Anderson chairs. While acknowledging that his human trial was pathbreaking, many of Anderson's colleagues say they are shocked by the breadth of the patent. Joseph Glorioso, head of the Department of Molecular



Commenting on one company's patent, originally granted but then overturned, that encompassed all genetically engineered cotton, John Barton of Stanford University says that "such claims seem more strict than is necessary for encouraging innovation."



Genetics and Biochemistry at the University of Pittsburgh, told the journal *Nature* that most of his colleagues felt "deep disbelief" about the patent, adding that it "is analogous to giving someone a patent for heart transplants."

Bottleneck at Group 2300

Just one building and a world away from patent examiner Ponrening, Group 2300, which issues patents on computer software, exudes an aura of fast-paced change. Alan MacDonald, a supervisor and senior examiner, leads a brisk tour of the area. Having burgeoned over the past five years, Group 2300 is now one of the Patent Office's largest departments, employing nearly 200 examiners and occupying one and a half floors. The document-handling room is on the scale of a city post office. MacDonald says that although the department used to be divided into two art units, it now has fifteen and faces some 15,000 pending applications. These cases are often notoriously complex: MacDonald points out shelves upon shelves of jumbo folders, many over a foot thick.

MacDonald, whose specialty is artificial intelligence and speech signal processing, can claim an unusually long tenure—11 years—with the group. (An examiner must work in the agency for 7 years to obtain full "signatory authority" to grant a patent.) As in the biotech field, once employees become proficient they tend to be snatched up at much higher salaries by firms desperate for an edge in pushing their applications through the system. Group 2300 therefore faces a severe shortage of experienced personnel. The bottleneck is particularly acute because the agency has promoted some of the group's most experienced supervisors to the Board of Appeals to deal with the multitude of software lawsuits. Although deputy commissioner Van Horn halfheartedly maintains that an exodus of talent to the private sector can smooth the overall application process, he acknowledges a "tremendous problem" in retaining examiners, and there is little question that the trend disproportionately favors firms that can best afford to lure away Patent Office staff.

Not surprisingly, given its demands and subject mat-

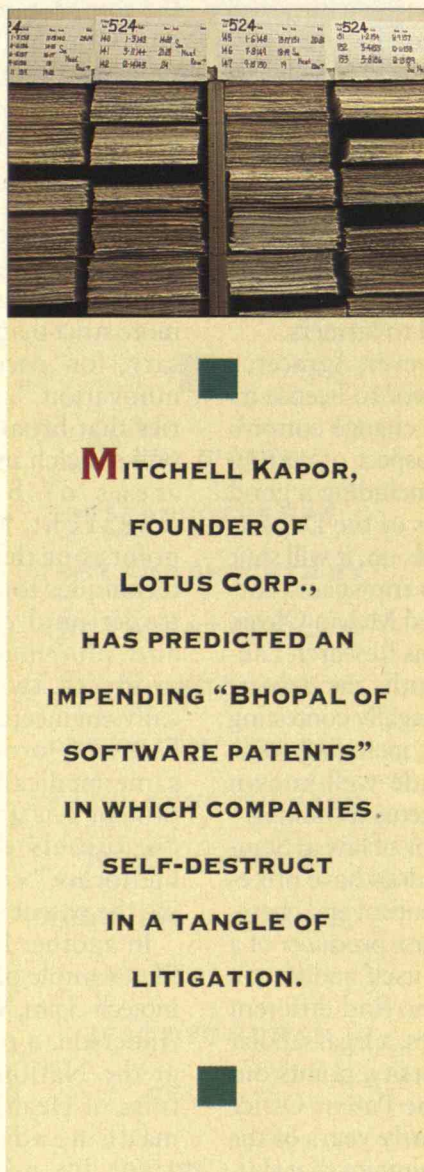
ter, Group 2300's working environment is more up to date than Ponrening's area. Among other amenities, employees boast access to a new database whose dual monitors allow examiners to retrieve both the graphics

and text of any existing software patent. Evaluating applications in this field is nevertheless difficult partly because programmers leave little or no paper trail when developing new software and contribute to few peer-reviewed journals. As MacDonald laments, "In this field especially, there is no magic book to help you track key advances." To compensate for this shortcoming in understanding "prior art," Group 2300 recently added a powerful computer system that can sift through stacks of CD-ROMs for any references to existing software in published literature.

Evaluating applications for software patents is also problematic because, computer programmer Stallman asserts, "software is the extreme opposite" of, say, pharmaceuticals, where one patent typically goes with one product. "A typical software patent covers many dissimilar programs, and even an innovative program is likely to infringe many patents." In one public meeting, Stallman produced a voluminous, unwieldy printout of a program he wrote with several colleagues, explaining that it is in use on more than a million computers today, including those of the U.S. Air Force and major companies like Intel and Motorola. "Just a few lines of code can be enough to infringe a patent, and this compiler has 10,000 pages," Stallman said, gesturing to the document. "How many patents does it infringe? I

don't know. Nobody does."

Like Stallman, many foresee gridlock and massive consolidation of the industry into big software firms as would-be programmers are stymied by the need to license dozens of patents simply to put out a single product. Mitchell Kapur, founder of Lotus Development Corp., has predicted an impending "Bhopal of software patents" in which companies self-destruct in a tangle of litigation. The problem is worsened by the fact that the field relied on copyright for protection until just a few years ago. "To mix a metaphor," says Boston University's Robert Merges, "the software industry changed its stripes in midstream."



As firms quickly realized the power and potential payoffs afforded by patents, many rushed to stake out protection for basic, early developments.

In one prominent battle, Apple, Microsoft, and Hewlett-Packard spent tens of millions of dollars in protracted litigation over a patent awarded to Apple for the "look and feel" of its user interface. (Microsoft eventually won the right to make its Windows program look and feel much like the Macintosh system because Apple had earlier granted the company a limited license in that area.) But underlying the dispute was a complication unique to the field—software routines are more like languages than tangible products such as razors, and programmers continually alter, reuse, and build upon techniques as they create different kinds of software and apply their styles at different firms. Wallace Judd, president of California-based Mentrax Corp., points out that when he helped design the Macintosh interface for Apple, "our implicit charter was to emulate software developed at Xerox PARC known as the Star interface"—a fact that was almost completely lost in the legal squabbles.

In another recent fight, a jury ruled that Microsoft owed the small firm Stac Electronics \$120 million for infringing its patent on a method for compressing data (thereby saving memory) in a recent version of Microsoft's DOS software. And in a lengthy case now on appeal in federal court in New York, the software firm REFAC is demanding 5 percent of all revenues earned by Lotus Corp.'s wildly popular spreadsheet program Lotus 1-2-3. REFAC claims that the Lotus program infringes its patent on a mathematical procedure that is integral to spreadsheets.

Responding to widespread concern over patenting in the software industry, Patent and Trademark Commissioner Bruce Lehman convened an unusual meeting in Silicon Valley in 1994. The vast majority of programmers who testified lambasted the current system. Calling software "fundamentally different from manufactured products," Jerry Baker, senior vice-president of Oracle Corp., warned that "software patents are failing to achieve the Constitutional mandate of promoting innovation and indeed are having a chilling effect on innovative activity in our industry." In the view of his sizable software firm, Baker said, "the patent system is on the brink of having a devastating impact on the software industry. In our opinion, copyright and trade-secret law are satisfactory to protect the developer's rights in software and to promote innovation in our industry."

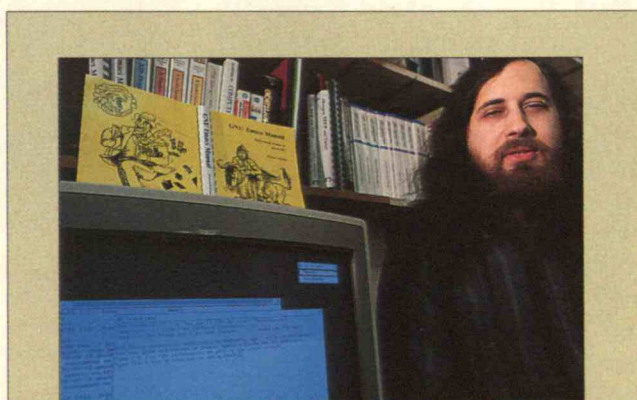
Toward Changing the System

Some observers assert that since a move back to copyright is unlikely at this point, a more realistic solution is simply to better educate patent officers. In the software field, for example, a group of programmers in

Ann Arbor is compiling a database of established procedures not widely known outside the field. "With the dramatic upswing in software patent applications," says the project's director, Roland Cole, "there was a general feeling that there would be disruption in the industry until something like this was done."

While most observers of the field welcome efforts such as Cole's, they recognize that the gap between examiners and their industrial counterparts may never be closed; the Patent Office will still tend to grant broad patents in this and other fast-moving high-tech domains. John Preston, director of technology development at MIT's Licensing Office, has therefore suggested a more fundamental change: that all patent holders be required to license their inventions for an established fee. Thus even if Agracetus won a patent for all genetically engineered cotton, say, or a software firm obtained protection for a basic operation, the companies would have to allow competitors to build on their techniques and bring related ideas to market.

Compulsory licensing is anathema to many participants in the U.S. patent system. Large pharmaceutical firms, especially, maintain that such a requirement would drastically dilute their profitability. But variations on such an idea might prove more palatable. In a forthcoming article in the *International Review of Intellectual Property*, for instance, John Barton of Stanford suggests a limited form of compulsory licensing in which patent holders must allow others to at least conduct research using the protected ideas. "I believe that when someone invents something, anyone should be entitled to experiment with it, even if those experiments are ultimately for commercial purposes," Barton says. "If, in the process, they discover something new, they



Richard Stallman, a prominent computer programmer and activist, says the protection of software "property" is fundamentally different from that of other industrial products because a typical program is often thousands of pages long and likely to infringe numerous patents.

should be able to tell the patent holder, 'I've got this wonderful new invention, but before I can market it I need a license from you.' " He predicts that most patent holders would grant the license.

Such a change may not occur without a greater groundswell, but international pressures are also building toward these and other moves. The United States is the only major country to issue patents to the party determined to be the first to design a given invention; agencies in Europe and elsewhere streamline the patent-granting process and reduce prospects for drawn-out lawsuits that often inhibit innovation by simply rewarding the first to file. Patent specialist Merges of Boston University and many others think the U.S. Patent Office should adopt a similar system. By putting the onus entirely on the initial inventor to file a claim rather than forcing a government body to sort out the originator of a given invention, such a change might well make software patents, for instance, less contentious, since determining who was the first to develop a programming concept is often extremely difficult.

Harmonizing the U.S. patent system with those abroad might also entail lengthening the protection period from 17 years to 20 years, with the clock running from the date an application is filed rather than the date a patent is issued. However, Stallman, for one, thinks that even if the agency makes this change, it can treat various fields differently. He would like to see patent protection for software *shortened*, to 3 years maximum, so that basic techniques quickly become public property and programmers do not face a legal minefield every time they write a line of code.

A concomitant policy to disclose even pending patents would help fast-changing fields such as biotech and software, where secrecy imposed during the 19-month (or longer) application process can slow innovation by discouraging collegial exchange of information at conferences. Unfortunately, a bill by former senator Dennis



PRESSURES FOR
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DeConcini (D-Ariz.) calling for many of these harmonization changes languished during the Senate's 1994 session without ever coming to a vote.

Nevertheless, negotiations conducted under the auspices of the International Trade Organization, the successor to the General Agreement on Tariffs and Trade as the world's main forum on international commerce, may force not only the United States but also other countries to consider the rapidly growing number of appeals for change in the world patent system. The British Parliament, in one sign of controversy abroad in the field of biotechnology, recently rejected a directive that would have allowed the patenting of human genes and gene therapies; the European Patent Office is now wrestling with policy in that area. A recent blue-ribbon British panel, decrying a "patent plague" that is sparking fundamental disputes in several high-tech fields, also called for a revision of critical parts of the European Patent Convention. And the journal *Nature* editorialized earlier this year, "The need for changes in world patent legislation becomes more clamant [urgent] every day."

These pleas underscore the fact that intangible concepts vital to the information economy often differ dramatically from the mechanical inventions the U.S. Patent Office and other agencies were established to protect. Indeed, Anne Wells Branscomb, a lawyer and author of the recent book *Who Owns Information?*, suggests that software and other "crown jewels of the information economy" may be so important that they deserve a new system of legal protection.

In any case, if domestic and international decision makers do not begin to consider how to modify existing policy, we are likely see more well-publicized reversals at the U.S. and other patent offices, more litigation in high-tech fields, and the almost certain squelching of innovation by dubious or overly broad patents. As Men-trix Corp.'s Judd points out, we all lose when firms seeking strong patent protection for a better mousetrap wind up "patenting the idea of trapping mice." ■

MITnews

FROM THE ASSOCIATION OF ALUMNI AND ALUMNAE OF MIT NOV/DEC 1995

Bio medical Engineering

New Program and Center Put Flesh on the Bones

By Richard Anthony

Janet Sollod, '96 has firm career plans. "I've always wanted to be a doctor," she says. "That's what I'm interested in. That's my goal."

As a result, by the time MIT accepted the Hillsdale, Calif., native, she'd already chosen biology as her major. But once on campus, she decided to augment her plans. "Since I was at the best engineering school in the world," she says, "I felt that I might as well get an engineering degree, too, and basically learn how engineers think."

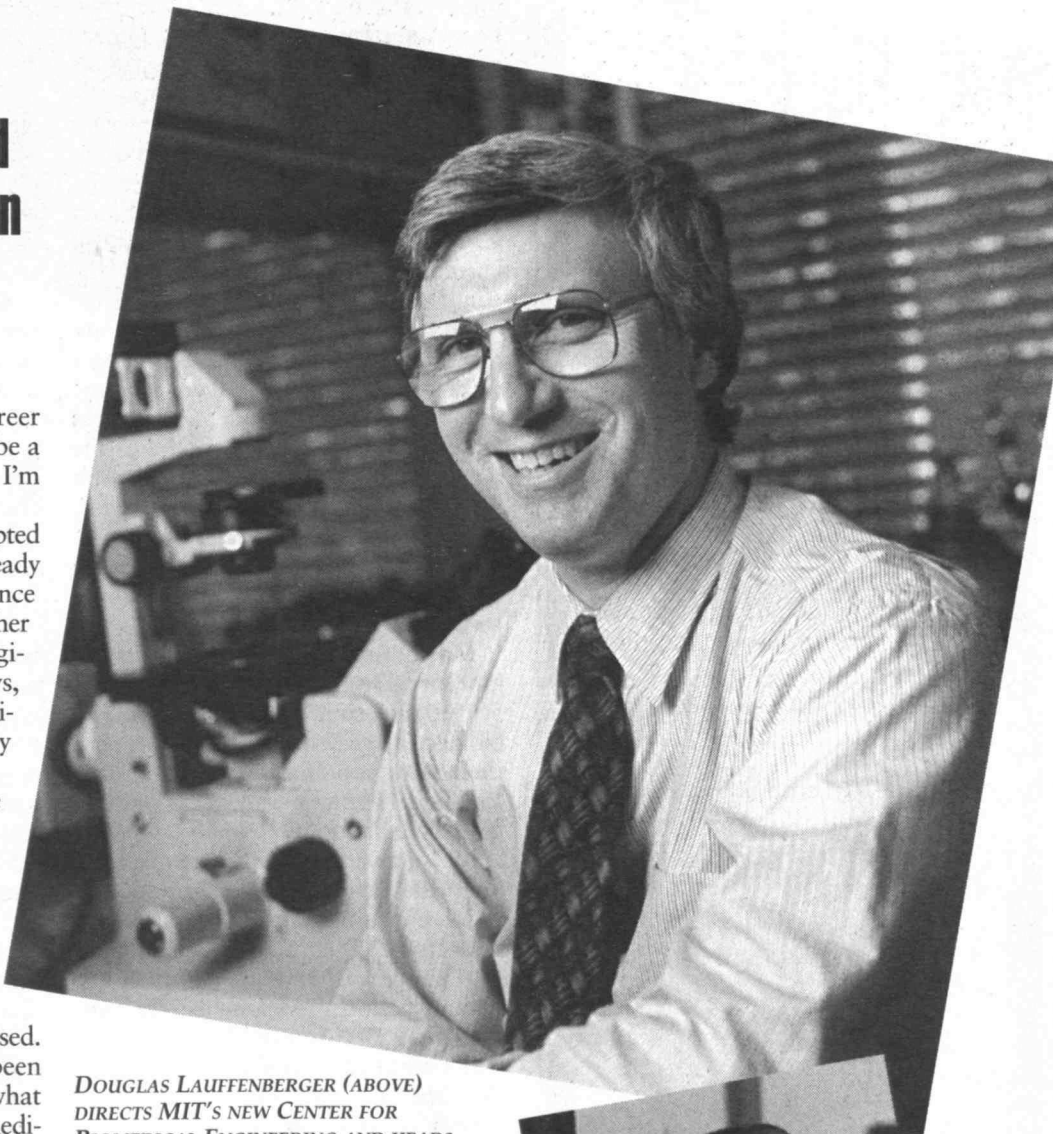
Ideally, she would like to have added biomedical engineering to her biology training. But at that juncture, it was not a formal option. "I chose chemical engineering because it was as close to biomedical engineering as I could get," says Sollod.

Not that the issue hadn't been raised. "For years now, freshmen have been asking the Department of Biology what to do if they were interested in biomedical engineering," notes Gene Brown, professor of biology and former dean of science. "Our standard answer was that they should either major in engineering and take some biology courses, or major in biology and take relevant engineering courses."

To help them design a credible program of study in the field, students had to track down ad hoc advisors from among those faculty who had the appropriate expertise but no formal

DOUGLAS LAUFFENBERGER (ABOVE) DIRECTS MIT'S NEW CENTER FOR BIOMEDICAL ENGINEERING AND HEADS THE NEW UNDERGRADUATE MINOR IN BIOMEDICAL ENGINEERING. **JANET SOLLOD, '96 (RIGHT)**, IS A PRIME EXAMPLE OF THE KIND OF STUDENT WHOSE DIVERSE GOALS, INVOLVING ENGINEERING AND BIOLOGY ALIKE, THE NEW PROGRAM IS DESIGNED TO SERVE.

mandate from the Institute. Now, there's a more straightforward option: Effective this fall, MIT is offering a minor in biomedical engineering.



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Hard Choices

Class secretaries know only too well that we have long been watchful of unnecessary verbiage. "Extra pages cost money," has been our mantra for years. But things are even more serious now: Since July 1994, the cost of paper has increased by 70 percent, industry wide. And on a campus in the midst of reengineering, nobody is free to exceed budget, whatever the reason. At the same time, we are blessed with ever-fatter sections of Class Notes and Course News (thanks in part to e-mail) and the usual excess of riches in terms of lively and interesting alums to feature. Convinced, as we remain, that communication is essential to keeping alumni and alumnae connected to and supportive of MIT, we nevertheless will be running an even tighter ship henceforth, and we thought we ought to keep you informed.—SUSAN LEWIS

Bio medical Engineering

The new minor—the first formal interdepartmental program for undergraduates—involves offerings from several different departments, including Biology, Chemistry, Electrical Engineering and Computer Science, Chemical Engineering, and Mechanical Engineering. It's also the first degree program to be administered by an interdisciplinary entity—the new Center for Biomedical Engineering (CBE), to be housed in Building 56—instead of a department.

"The people involved in the minor, to a large extent, are the same people involved in the center," notes Linda Griffith Cima, an assistant professor of chemical engineering and co-chair of the committee that developed the minor.

Though the minor and center are new, MIT long ago began compiling a track record in biomedical engineering. Institute contributions to the field include the first reliable model of the structure of bone and the "Boston arm"—the latter a prosthetic device, invented by mechanical engineering professor Robert Mann in the 1960s, that's controlled by impulses from the user's own nervous system.

Many future MIT contributions, moreover, seem assured: An estimated 50 engineering faculty are doing biomedical engineering research, most of them with collaborators from Boston teaching hospitals and other leading medical institutions.

MIT has an impressive pedigree in biomedical-engineering education, too. Available to undergraduates are such subjects as "Quantitative Cell and Tissue Physiology," and "Biomaterials-Tissue Interactions." Meanwhile, the Harvard-MIT Division of Health Sciences and Technology, jointly sponsored by the Institute and Harvard Medical School, provides doctoral-level training in biomedical engineering and physics, among other areas. Its offerings help explain why MIT's biomedical engineering program ranked fourth nationwide in the April *U.S. News & World Report* survey of graduate programs.

But if all this is going on already, why the need for something as formal as a minor? One reason was simple fairness, says Robert Jaffe, professor of physics, chair of the MIT faculty and a stout supporter of the new program. He says that

while MIT needs to be cautious about launching new initiatives, it also had to recognize that there was strong student interest in this instance. The minor enables MIT to acknowledge on a student's diploma the work he or she has done in this field, says Jaffe.

Flexibility was also part of the equation. Janet Sollod, for example, accommodated her interests by carrying full majors in both biology and chemical engineering, but that left no room on her schedule for selected EECS biomedical engineering subjects ("and I wanted to take those classes so badly," she notes.) With the minor, students no longer face such constraints.

But a key factor leading to action now was the perception that biomedical engineering's time has come—thanks in large part, says Linda Cima, to recent advances in biology. "Just as the emergence of a quantitative approach to chemistry paved the way for the field of chemical engineering," she notes, "progress in molecular and cell biology is making possible a major expansion of biomedical engineering."

The concerns of the field, though broad, include a strong focus on using natural processes to meet engineering goals. Thus, Douglas Lauffenburger, professor of chemical engineering and newly appointed director of the biomedical engineering center, notes that the way engineers approach the problem of replacing diseased, injured, or missing parts of the body is changing.

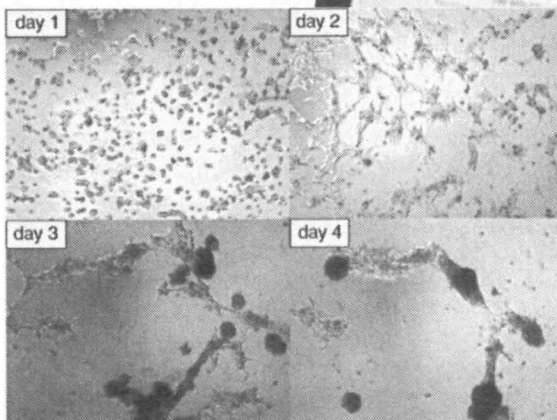
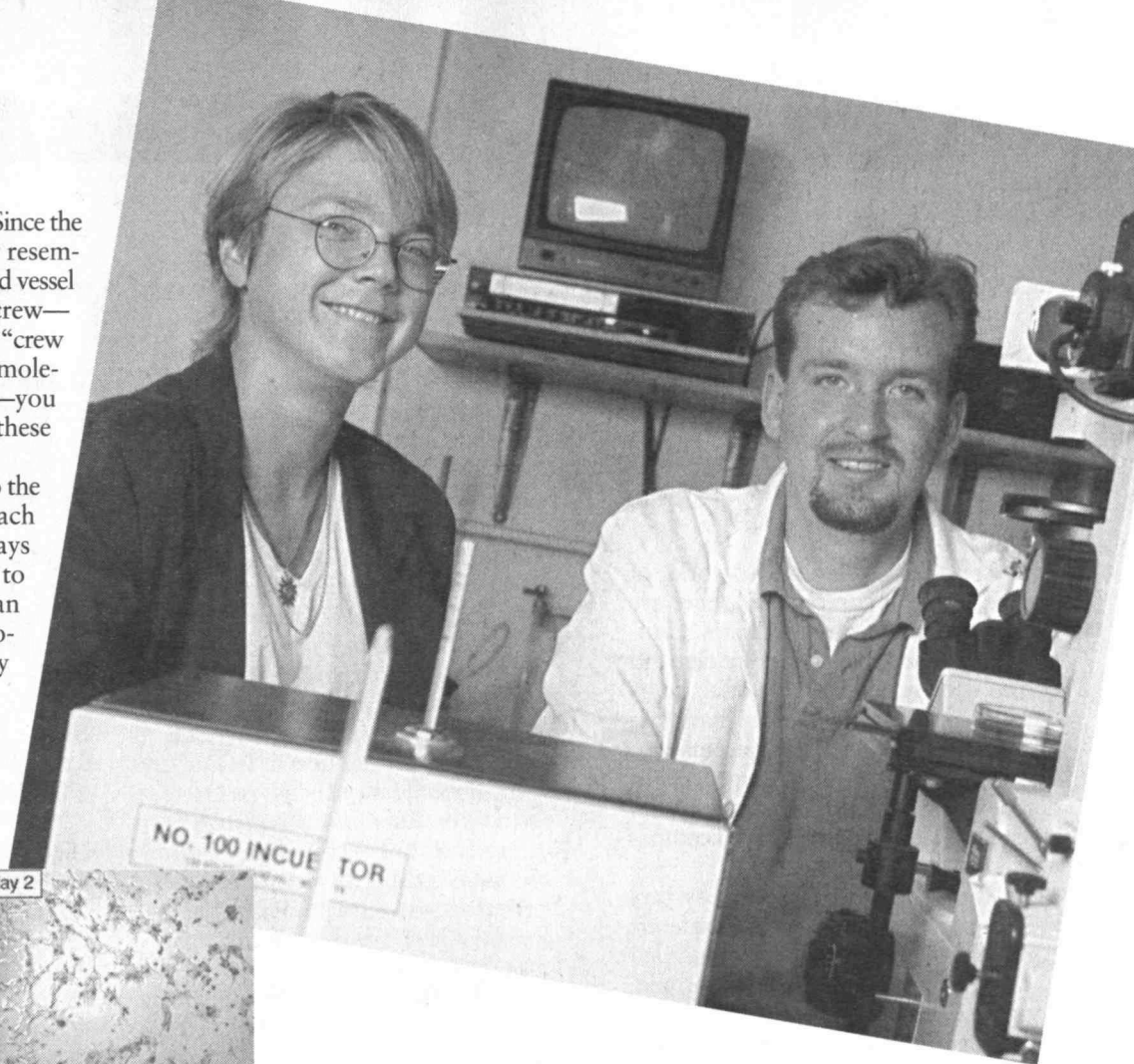
Traditionally, he says, you sought a substitute structure to do the job. "If [the damaged tissue] was bone, you'd say, 'Let me design a crutch, or let me make something out of titanium,'" he notes. "Now you can ask, How do we regenerate bone? What bioresorbable materials do we need? How do we get the right cells to replicate themselves?" In effect, the body becomes its own "factory," turning out new parts—not just bones but blood vessels, connective tissues, even whole organs—guided by engineers schooled in how to orchestrate natural processes.

At times, such work calls for understanding biological interactions occurring at scales so minuscule a light microscope can't capture them. Lauffenburger, for example, is interested in

growing new muscle tissue. Since the action of a muscle roughly resembles that of a human-powered vessel with a spectacularly large crew—that is, it involves millions of “crew members,” or individual molecules, working together—you need a detailed grasp of these micro-scale activities.

“The question is: how do the molecules interact with each other to generate force?” says Lauffenburger. “You have to understand that so you can stimulate or alter the molecules to operate in the way you want them to.”

The complexity of these topics means biomedical engineers need sophisticated training. One of



LINDA CIMA (TOP LEFT), ASSISTANT PROFESSOR OF CHEMICAL ENGINEERING AND A LEADING ADVOCATE OF THE NEW MINOR IN BIOMEDICAL ENGINEERING, IN HER LAB WITH DOCTORAL STUDENT MARK POWERS. HE IS STUDYING THE AGGREGATION OF HEPATOCYTES—THE PRIMARY LIVER CELL—GROWING IN VITRO (ABOVE), WORK THAT HE HOPES WILL SOMEDAY CONTRIBUTE TO EFFORTS TO GROW NEW ORGANS FOR PATIENTS WHOSE LIVERS ARE DAMAGED BY INJURY OR DISEASE.

Lauffenburger's job is to make sure MIT students get that, and his colleagues say he's the right person for the task.

The director of the new program came from the University of Illinois, where he was a professor of chemical engineering and cell biology. He was the overwhelming choice to head MIT's new

research center and oversee development of an expanded educational program—if the Institute could get him.

“Doug was being recruited by a number of other universities,” says Linda Cima, “so we had to move quickly. The idea of a new biomedical engineering center was hatched a year ago June, and MIT had hired Doug by the fall.”

Lauffenburger says the decision to go with MIT was not difficult. “I believe that one of the ways to advance a field is to go where you can have the most influence,” he says, “and MIT has always been a place that people look to for leadership.”

Ironically, the Des Plaines, Ill., native didn't set out in life to be a biomedical engineer. His original aim was to be a chemical engineer in the traditional mode. And had it not been for slack period at an early job, he might never have wavered from that course.

“I was working at an oil company and my project wasn't all that challenging,” he says, “so I went to the library. I ran across a book called Chemical Engineering in Medicine and Biology and started to read it. I saw all the principles that I'd been taught applied to things like artificial kidneys and artificial lungs, and I said to myself, ‘Wow!’”

When he later went to grad school, at the University of Minnesota, he continued in chemical engineering but also took courses in biology. “I was drawn by the intellectual challenge—the idea of using living molecules, cells, and tissues to do engineering instead of more traditional tools.”

Lauffenburger notes that MIT already offers many of the courses needed for the new minor. Students in the program must take two biology subjects: biochemistry and molecular or cell biology. There are also required engineering classes, and a host of choices for electives in engineering. All are part of the existing curriculum, although Lauffenburger and his colleagues also planned to start developing new curricular offer-



ings this fall.

The best curriculum in the world, of course, won't mean much if there are few jobs waiting for its graduates. Lauffenburger concedes that present demand comes mostly from traditional quarters—for instance, firms that manufacture CT scanners or cardiac pacemakers. But he also foresees an upsurge in demand for biomedical engineers from enterprises like drug and biotech companies.

As the drug-creation business gets increasingly sophisticated, contends Lauffenburger, engineers will be needed to do new kinds of tasks: For example, designing polymer-based delivery systems that can be implanted in the body to ensure the slow release of drugs over weeks or months.

Another source of jobs would be start-up firms built around new technologies. "Companies are springing up that want to regenerate cartilage or the pancreas or liver," he notes, "and they need engineers who understand both the engineering issues and the underlying biology."

Students who dream of moving into such jobs would do well to come to MIT to prepare, Lauffenburger believes. The key traits for a successful biomedical engineer, he says, are a strong background in engineering, a firm grasp of biology, and ample exposure to real-life medical environments. "MIT's biology program is the best in the country," he notes, "so is the Boston-area medical community, and we have the most outstanding engineering school in the world."

"I've always felt that if you want to do something, you should try to do it better than anyone else," he adds. "In my judgment, there's no reason this place can't have the best biomedical engineering program in the world." □

MIT Clubs Are Alive a

Across the nation and around the world, MIT Alumni Clubs draw thousands of alumni/ae, parents, students, and friends to a broad range of social and educational activities. Since MIT clubs reflect the diversity of our alumni/alumnae body, events range from faculty speakers to career workshops, from plant tours to opera, all in an effort to promote the Institute and provide enlightenment about its programs. In addition, a number of clubs have a public service entity in which one may find people tutoring high-school students or painting a shelter for battered women.

Club leadership is drawn from local alumni/ae volunteers who serve as officers or board members and often rise to positions on Alumni/ae Association national boards and committees. Each club sends out annual membership invitations, usually with its first fall event announcement. If you haven't received your invitation yet, respond now by looking up the club president or alumni/ae staff person in your area on the following list.

We look forward to seeing you soon and often at MIT Club activities and welcome your support.

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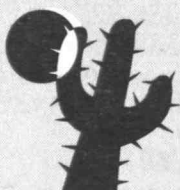
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Making the Case for Research

It was a strange sight on television one hot August night: there was Michael Jackson, the entertainer, online—answering questions from fans via modem. Clearly, it was not his medium; he is more effective on stage. But the fact that he was even being presented on the Internet was yet another sign of how much potential people see in computer communication.

Increasing numbers of people use computers and other modern technologies daily, but few stop to think about how those technologies were developed—or about the critical role that research universities play in that development. Scientists and engineers may have been too busy bringing forth the incredible wonders of personal computers and the Internet in recent decades to think about communicating about their work by offering a clear voice in Washington and on Main Street. Now, as the budget axes swing, research projects and research universities like MIT appear to be easy targets that won't trigger outrage from voters.

One of the people who has seen clearly the need to make the case for research and research universities, and is at work doing just that, is MIT's president, Chuck Vest. In a fascinating speech at the National Press Club last summer, he argued effectively for continued support, calling it "an investment in the future quality of life, health, and welfare of the American people." (*The text of Vest's speech was published in the October MITnews.*—Ed)

On that occasion, he quoted from a joint statement—run as a full-page ad in a number of the country's leading publications—by the chief executives of 16 major American corporations:

"Imagine life without polio vaccines and heart pacemakers. Or digital computers. Or municipal water purification systems. Or space-based weather forecasting. Or advanced cancer therapies. Or jet airlines. Or disease-resistant grains and vegetables. Or cardiopulmonary resuscitation."

"That and much, much more," Dr. Vest went on to say, "is what science and technology and our nation's universities have made possible. But today, rather than building upon this success, we are about to undermine it."



As he noted, much of the basis for the funding of science and technology research in the last 50 years was laid after World War II by Vannevar Bush, '16, an MIT engineer and leader of the country's wartime science effort under President Franklin Roosevelt. Dr. Bush convinced policymakers that science and technology were essential to the health of the nation, and he articulated essentially the policy of government-sponsored research that we follow today.

Other developments helped keep the public interest in science and technology alive. The Soviet Union's launch of *Sputnik* in the 1950s, for example, was useful in whetting the American public's appetite for science. But it was an interest that faded almost as quickly as it had arisen. As the hit movie reminded us during the summer, by 1970 the public had grown so blasé about such events that the launch of *Apollo 13* did not show up on the national news.

We can hope that the Tom Hanks movie captured the imagination of young viewers who will be inspired to dig into math and science—and perhaps head for MIT some day. But it takes more than a popular movie like that to shift public attitudes and to make the case for the national interest in funding basic research.

Nor is a nation's research capability something you can turn on and off like a faucet. In part, that capacity depends on grabbing the interest of the very young, and then giving them the appropriate training so they will be ready to attend a school like MIT. Maintaining research capacity also requires supporting the universities themselves—the

research projects, the students, the faculty—so they can keep on pushing outward the frontiers of knowledge.

But even as research progresses, those involved cannot forget the need to keep the public interest alive. One timely project that may help in that regard is a new series of books commissioned by the Alfred P. Sloan Foundation in New York, each one on the history of a different modern technology.

The series of more than 20 books will cover everything from computers and radar to nuclear power and biotechnology. Victor McElheny, director of MIT's Knight Science Journalism Fellowship program, is on the advisory committee for the series and is writing a biography of Dr. Edwin Land, the inventor of instant photography. The books in the series will appear over a number of years, with the first one, *Dark Sun: the Making of the Hydrogen Bomb*, written by Richard Rhodes and published by Simon & Schuster, coming out this year. *The Making of the Atomic Bomb*, Rhodes's earlier volume, was highly acclaimed and won the Pulitzer Prize.

Books like these can certainly help inform the public. But the responsibility is a broader one. Those who are involved in science and technology need to teach others. More than ever, there is a need for articulate voices and wide public discussion. It may well be necessary for Congress and the White House to watch budget growth more carefully. But the process should be a considered one, and those in our community should not shrink from offering our views and expertise, in any forum, large or small. (*See an article making a similar point by Rep. George E. Brown, Jr., on page 40.*—Ed)

If people like Michael Jackson can be sold on the virtues of cyberspace, there should be room to discuss how cyberspace came into being—and how the equivalent technologies of the 21st century will be born. □

Karen Arenson

KAREN WATTEL ARENSEN, '70, President, Association of Alumni and Alumnae of MIT; 125 W. 76th St., Apt. 2A, NY, NY 10023; e-mail: <arenson@nytimes.com> or <dhhbm13d.prodigy.com>.

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Please send news for this column to:
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Pocasset, MA 02559

17

Please send news for this column to:
D.P. Severance, '38, acting secretary,
7 River Woods Dr.,
F219, Exeter, NH 03833

18

Please send news for this column to: Class Notes Editor
Technology Review
MIT W59-200, 77 Mass. Ave.
Cambridge, MA 02139

19

Please send news for this column to:
Bill Langille, secretary
20 Rogers Rd.
Far Hill, NJ 07931

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Please send news for this column to: Class Notes Editor
Technology Review
MIT W59-200, 77 Mass. Ave.
Cambridge, MA 02139

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75th Reunion

A towering loss to the entire MIT community, to our country, to his family, and to the Class of 1921 is the passing of a distinguished and longtime class officer. **Samuel Eugene Lunden**, architectural engineering, a brilliant architect, staunch friend, civic enthusiast, loyal supporter of MIT, and long noted as 1921 assistant secretary, died in his sleep June 10, 1995, in his palatial home in Rancho Palos Verdes, Calif., at age 97.

A member of that exceptionally capable group of 1921 artisans—many of whom opened successful offices in principal cities along the Pacific Coast—Sam endeared himself to 1921 in service to the class during his seven decades of heading his Los Angeles offices for design of now famous classic and art deco structures which have been cited as “an indelible stamp on downtown Los Angeles.”

He is specially known for such landmarks as the Doheny Memorial Library at USC and the old Pacific Stock Exchange building, the Biltmore Hotel, and the interiors of St. Vincent de Paul Church and his own Spanish-style home in Rancho Palos Verdes where he and his

charming and surviving wife, Leila, reared their three children.

Sam was proudest of his 1960 Las Palmas School for Girls, East Los Angeles, as a prototype for correctional institutions—now the Dorothy Kirby Center. He told some of us he was asked to “make it nice for girls” and “pleasant, not like a jail.” He commented, “That’s just what we did!”

Besides public and office buildings, Sam’s talents included much space planning, city planning, master planning, and interior design. One of his urban planning projects which never was completed, was “Carveyor,” a 1956 plan to move six passenger cars on conveyor belts at 15 mph through downtown Los Angeles at 15 feet above street level.

Sam was honored in being named a fellow of the American Institute of Architects, which also elected him to the office of national president in 1965. He won the organization’s Edward C. Kemper Award for “significant contributions to the institute and to the architectural profession.”

Sam’s ability to visualize gained early experience when, after World War I, he was chosen one of 50 young American architects and engineers sent to rebuild France. At our 50th Reunion, he told us, “We were ordered to find Verdun under the rubble and to reestablish the lines of the city!”

Because all the MIT architecture courses were retained in the old Boston buildings while the rest of us enjoyed being the second class to spend all four years on the new Cambridge site, we knew few of the men and women in the architecture courses. So, it has been a real pleasure to get to know each other at reunions in late years.

Sam prepared for MIT at Pasadena High School and Caltech. At MIT he was a member of the Architectural Society and the California Club. As an alumnus, he became a major fund-raiser for MIT and was an early recipient of MIT’s top award, the Bronze Beaver, for “Distinguished Service” in creating an endowment for graduate students in urban planning.

He was active for many years in Los Angeles’ prominent civic club, Town Hall, and was its president in 1965.

Leila and Sam were married for 70 years and we immediately phoned her to offer deep sympathy from the entire MIT community. She told us she was doing fairly well. Also surviving are a son and two daughters, a sister, three grandchildren, two great-grandchildren, and several nieces and nephews.

Will you please be a “greeter” to help celebrate our 75th Reunion luncheon party during Technology Week in early June 1996? Write now and say “yes!”—**Carole A. (Cac) Clarke**, president and secretary, 608 Union Ln., Brielle, NJ 08730-1423; tel: (908) 528-8881

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Please send news for this column to: Class Notes Editor
Technology Review
MIT W59-200, 77 Mass. Ave.
Cambridge, MA 02139

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I am calling upon all of you who read this column to help me bring our roster up to date. My records show 52 classmates as living. Some of them may have passed on. In

this issue and the next two issues of the *Review*, I will list the names of the classmates who, according to my records, are still living. If you should have any information to the contrary, please contact me with any details that you may have.

For this issue, I list: **William J. Boesch**, **Sten Branzell**, **Frank S. Archer**, **John W. Beretta**, **Rodger D. Brouwer**, **Earl D. Brown**, **George A. Brown**, **Lewis N. Brown**, **Edward H. Burkart**, **Frederick H. Chirwin**, **Ralph W. Christie**, **Franklin G. Clement**, **Winthrop K. Coolidge**, **Arthur C. Craig**, **Roswell B. Daggett**, and **Henry S. Davis**.

Edward Battey passed away May 4, 1995. Ed was an advertising executive, a member of the University Club of New York and was a member of the Riverside Yacht Club. His avocations including foldboating, speed skating, figure skating, water skating, skiing, hiking, camping, and mountain climbing.

Keep the faith!—**Royal Sterling**, secretary, Apt. D201, 2350 Indian Creek Blvd. W., Vero Beach, FL 32966-5103

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Please send news for this column to: Co-secretaries:
Katty Hartford, 237 Hacienda Carmel, Carmel, CA 93923;
Colonel I. Henry Stern, 2840 S. Ocean, #514, Palm Beach, FL 33480

25

Jia Yang Shi has written to **Sam Spiker** expressing his great love for MIT and his sorrow at not being able to attend the 70th Reunion.

Also, he noted that a donation had been sent to the Alumni/ae Fund which would be credited to the Class 70th Reunion Fund. Shi had a career in education and his accomplishments are such that he can be justifiably proud. With his letter, Shi included a brief biographical sketch which should be of interest to classmates. He received an SB in mechanical engineering in 1925, continued at the Institute and was awarded an SB in electrical engineering and an SM in mechanical engi-

neering in 1926 and 1928. He managed to find time to go to Cornell and obtain an MS in civil engineering 1927. Returning to China from 1930-37 he was a professor and head of the Department of Civil Engineering at Tsinghua University in Beijing. From 1937-52 he was dean of the College of Engineering. Shi was elected and served as president of the Chinese Hydroelectric Society 1981-85. He is now honorary president of that Society.—**F. Leroy (Doc) Foster**, secretary, 434 Old Commons Rd., P.O. Box 331, North Chatham, MA 02650

26 70th Reunion

Please send news for this column to: **Donald S. Cunningham**, secretary, c/o Ronald F. Frazier, 132 Middle St., Braintree, MA 02184

27 **Francis J. Guscio** of Tucker, Ga., died on March 15, 1995, at the age of 88. After graduating from MIT, He worked for the Port of New York Authority and later the National Park Services. In 1942, he joined the U.S. Army Corps of Engineers and became chief of environmental engineering of the South Atlantic division. During his career, he initiated coastal ecology studies and military planning. This involved aquatic plant, water, and air quality controls for the South Atlantic division. After retirement, he was a consultant for the World Health Organization from 1976 until 1978.

When Francis started with the Port of New York Authority as a junior civil engineer, he was assigned the design and supervision of construction for the Riverside Arch to the George Washington Bridge. It was opened by Governor Franklin Roosevelt in 1931. Quite an accomplishment for a 24-year-old MIT graduate!

After two long illnesses in two nursing homes, **Lee MacCanne** of Old Lyme, Conn., died on June 27, 1995. Lee was for many years with Stromberg Carlson Co. of Rochester, N.Y., becoming VP and general manager before the firm was sold. During World War II he was a "Dollar a year Man" with the Office of Price Stabilization in Washington. After retiring from Stromberg Carlson, he taught business at the Rochester School of Technology and was a director of Rochester Chamber of Commerce and historian of Monroe County, N.Y.

We send our condolences to the families of these two classmates.—**Joseph C. Burley**, secretary, 1 Harbourside Dr., Delray Beach, FL 33483; **Lawrence B. Grew**, assistant secretary, 21 Yowago Ave., Branford, CT 06405

28 Even with delaying until the last minute for possible news for this issue of the *Review*, there is none at hand concerning the normal reportable items of deaths, professional events and honors, or MIT related interests. But there are members of our class who are still enjoying far flung recreational activities.

Class Agent **George Palo** has recently had an extended trip to explore the Norwegian fjords by ship from a visit to England, and **Gabe Disario** has been to Prague, London, and St. Petersburg with members of his family from Venezuela and the United States.—**Ernest H. Knight**, secretary and president, 168 Al Plummer Rd., Raymond, ME 04071-6349

29 Please send news for this column to: Class Notes Editor *Technology Review* MIT W59-200, 77 Mass. Ave. Cambridge, MA 02139

30 Supplementing last month's report on the 65th Reunion, we have at hand several communications from classmates expressing their regret at being unable to attend the

reunion. **Jack Bennett**, who as previously noted had a "debilitating stroke" in December 1994, is "in an excellent facility for stroke victims, known as Shell Point Village on the outskirts of Fort Myers, Fla." He was not sufficiently mobile to make it to the reunion, but sent warmest regards to those who would be attending. . . . During the **Tom O'Connors** annual spring trek from Key Largo, Fla., to Milton, Mass., Frances kindly filled out one of my information forms and returned it to me. Unhappily Tom is "now ill and confined to a wheelchair." Their son, Tom Jr., is now running the Thomas O'Connor & Co. construction company founded by Tom Sr.'s father.

Irving Dow writes from Mitchellville, Md., that while he had been looking forward to attending the 65th Reunion for the past four years, it was not possible for him to make it. In a recent telcon with **Ted Ross**, Irv learned that in April Betty and Ted made the move to a life-care facility in Fort Wayne, where they have lived for many years. . . . The **Win Hartfords** are about to make a similar move. Win says he and Mary plan to sell their Charlotte, N.C., house and go to a "Baltimore retirement community in 1996." Win will work on a history of chromium in the United States to be titled, *Fells Point, Baltimore, and Chromium (1809-1985)*.

We have at hand reports concerning the deaths of three more of our classmates: **Robert Nutting** on March 3, 1992; **John Parmakian** on August 15, 1994; and **Ed Giroux** on April 18, 1995. Unfortunately I do not have any information on Robert Nutting other than that given in the *Alumni/ae Register*. From that source it appears that he received an SM in course X-A and worked in Du Pont's pigments department for many years. He was living in Yorklyn, Del., at the time of his death. . . . After graduating from MIT, John Parmakian obtained an MS degree from the University of Colorado and thereafter had a distinguished career with the Bureau of Reclamation in the Denver area. In 1963 he resigned from his government job and became a self-employed consulting engineer on worldwide projects, e.g., hydro power plants, pumping plants, and pump storage power plants. In 1987, he won the ASCE Rickey Medal for "his illustrious career relating to designing hydromechanical equipment for hydroelectric projects and for his significant contributions to the literature

on waterhammer phenomena." His other awards include a Bronze Star for formulating and executing plans for the anti-aircraft defense of Iwo Jima, and a 1969 Distinguished Engineering Alumni Award from the University of Colorado. His book *Waterhammer Analysis* has been translated into five languages. John's avocation was mountain climbing, both in Colorado and Switzerland. As of 1988 he was living with his wife, Adele, in Boulder, Colo., and had a son, three daughters, and nine grandchildren. I do not have any up-to-date information on his family situation. . . . After graduating from MIT in Course IV, Ed Giroux worked briefly as an architect for Shipley and Bullfinch. When that office closed during the depression, he started teaching mechanical drawing and later mathematics in the Somerville schools. Later he taught at the Newton South High School until his retirement in 1969. In the mid-1960s Ed and Mildred acquired a 1794 farmhouse in West Baldwin, Maine, and remodeled it as a summer home. After Ed's retirement the Giroux shuttled between their Maine farmhouse and a winter home in Pompano Beach, Fla. Also, they became serious artists, exhibiting their works in both Maine and Florida and winning numerous ribbons and awards. In general Mildred's paintings are "impressionistic" and Ed's are "representational." Some years ago Ed reported that he had sold all the paintings he exhibited at one showing. In addition to Mildred, Ed is survived by a son, Gerald, also of West Baldwin.—**Gordon K. Lister**, secretary, Apt. 40-D, 5707 Williamsburg Landing Dr., Williamsburg, VA 23185

31 65th Reunion

Please send news for this column to: **Wyman P. Boynton**, secretary, 668 Middle St., Portsmouth, NH 03801; tel: (603) 436-1309

32 **Tom Weston** reports that the Hawaii trip was too small to call it a reunion. **Charles Martin**, Rose, and he really enjoyed their meeting with Savina and Manley St. Denis.

Tom sent some pictures to prove he was there. We are printing the one of Charles Martin and Manley St. Denis (see photo at right).

Arthur Marshall, who has been our class treasurer for three years, is reducing his activities and has resigned. He sent in his formal report as of May 31, 1995. It shows that we broke about even for our 60th Reunion. Our 1994 mini-Reunion in Tucson diminished our class bank balance by about \$150. Our remaining balance in the bank is \$585. Thank you, Arthur, for a job well done!

Beth Garvin, director of class programs for the MIT Alumni/ae Association, informs us that two students were chosen to receive the 1994-95 scholarship from the Class of 1932. They are Michelle Neben of Lexington, Nebr., who received the award last year, and Joseph Lee, a sophomore from Warminster, Pa.

A junior in 1994-95, Michelle continued to excel in her biology major at MIT. She hopes to enter the medical profession and plans to apply either to medical school or to a joint

medical/PhD program after graduation. Michelle's outside interests include art and music (she sings with the MIT Concert Choir), and she serves as the editor of the student-published *Course Evaluation Guide*. Michelle also rows for the women's crew and volunteers for the Admissions Office's "Project Contact," which puts prospective students in touch with current MIT students from the same geographic area.

This year Joseph Lee chose a major in chemistry and is also considering a medical career. He also pledged Sigma Chi fraternity and has already held a couple of leadership positions. Outside of the classroom and the fraternity this year, Joseph was a member of the men's varsity crew and was on the tennis team. He also enjoys singing madrigals and was in several a capella groups on campus. In addition, Joseph is a first degree black belt in kung fu and serves as an instructor in Shotokan and tae kwon do.

Thank you for the contributions made by you and your classmates towards this fund. The continued generosity of so many alumni/ae allows the Institute to sustain its commitment to these fine students.

Lee Tyburski writes from Mountain Top, Pa. He and his wife are in close touch with his daughter and son in California. They visit each other quite often. On Lee's next trip to California, he hopes to visit Jack Kearns.

We have received the sad news that Charles Harold Pierce died in December 1991, and that John Tremain Kelton died on March 4, 1994. When I receive more obituary information, I will pass it on to our classmates.

Write! Write! Write!—Melvin Castleman, secretary, 163 Beach Bluff Ave., Swampscott, MA 01907

Student Center entitled "Economics of War and Peace." The question "As we become a global industrial economy, can we make peacekeeping multinational?" was offered for discussion. In light of today's news about possible intervention in Bosnia, the discussion proved relevant to our problems in that senselessly inhumane ethnic conflict.

On a lighter vein, those who were at the Pops Concert might have surmised that the conductor of the orchestra—in his opening concert with the Boston Symphony that evening—would become somewhat of a cult figure as he ascends to the position which Arthur Fiedler began in 1930 followed by John Williams in 1980. Of course I am speaking about Keith Lockhart who, at age 35, has outdone rock stars and sports icons to become a screaming sensation after his official debut at Boston's 4th of July Esplanade Concert. Even the staid *Chicago Tribune* printed a picture of Keith conducting the 4th of July concert along with an eye-popping writeup befitting Boston's new idol. Keith says he never would have thought that he would sport a mustache or have his teeth blacked out in pictures of himself in Boston's subway stations. Interestingly, Arthur Fiedler began with the Pops at age 35 as well and held that position for 50 years.

Continuing with 62nd Reunion happenings, this really happened! Harry G. Steinman, he of the many charms, informed me that the *Technique* of 1933 is to be seen lying open to page 118 at the food counter in the McCormick dining room with the photo of our Harry in the front row of the squash team. I had Harry walk me over and there it was—Harry and his team members posing for the first squash team to be recognized as a sport by MIT. I am sure

their coach, Jack Summers, had to do with the recognition of the sport since he was the national professional singles champion of the time. One never knows what lurks there in Harry's head but between his buddy, Edward R. Atkinson, and himself, they can keep you wide-eyed and gullible. . . . Having read in the August/September issue of *Technology Review* that George V. Sweetnam's demise and case history was "most baffling of the many deaths I have to report," Maurice B. Marshall, '34, writes that I should contact

George S. Maynard, Jr., about Sweetnam since he says our George Maynard's father was manager for United Carr Fastener at the time Sweetnam was sales executive for that same company. Marshall also adds that he, Sweetnam, and Maynard were all graduates of Newton High School although he entered MIT one year after our '33 classmates. But George Maynard denied knowing George Sweetnam prior to 1940. However, up until his retirement in 1970, he used to see Sweetnam four

ClassNotes

or five times a year.

If you have not received a mailing on the status of the newly established Memorial Fund, we now have this fund which will simply add to the scholarship fund previously established as the "Twenty-five Year Gift of the Class of 1933." The fund will be officially described as: "Established as a Twenty-five Year Gift of the Class of 1933." Any memorial donations to this Fund should be made "In the name of" any member of our Class to honor that person in perpetuity. . . . They say talk of the weather if you want to continue a conversation. I was appraised of the change of address of our class president, Wilber B. Huston on July 7. He was relocating to Fountain Hills, Ariz. Then I read in the *Chicago Tribune* of July 10 that that community was close to a raging firestorm, which fire fighters tried to contain in temperatures of 106° F and above. My heart dropped to my feet when my phone calls did not get through. Finally, I heard from Bill that he had not made the physical change of address until some time after that reported calamity. I know what 106° F is like (really a heat index of 120 degrees) since Chicagoans have just experienced that all-time record temperature accounting for over 500 heat-related deaths this mid-July, most of whom are elderly shut-ins. I have no substantiation of any deaths to report at this time and for that I am most grateful. But do continue to send me any current news items even if you think your reporting is not newsworthy. I live for living subject matter.—Berj Tashjian, secretary, 1245 Briarwood Ln., Northbrook, IL 60062-4556; tel: (708) 272-8683

34

As we start our notes for this month, a few personal comments are in order. We had been quite comfortable in the heat wave of mid-July, where southerly breezes off the

waters of Lake Chagoggagoggmanchaugagoggchabunagungamogg kept us cool and comfortable in spite of temperatures approaching 100°. Then on Friday night the breeze died making sleep in our uninsulated cottage difficult. We were awakened on Saturday morning by the roar of a northwesterly and a sudden 20° drop in temperature. Everyone piled out of bed, awakened by the 40- to 50-mile-per-hour winds, and we scurried outside to get everything tied down. The storm roared through accompanied by a 15-minute downpour. The aftermath was another 95-degree day, but the winds dropped to about 20 mph and we enjoyed the most fantastic sailing in the 33 years we have had our O'Day Day Sailer. My son, daughter-in-law, Mollie, and I scrambled all afternoon to keep the boat upright while we literally tore around the lake. . . . A note from John Westfall's widow Ruth, thanking me for information we had sent to her regarding the Emma Rogers Society. For those of you who are not familiar with it, it is an organization of widows of MIT alumni and faculty. Ruth has found two members in her



CHARLES MARTIN, '32, AND MANLEY ST. DENIS, '32, AT THE IOLANI PALACE IN OAHU, HAWAII, LAST APRIL

33

A few afterthoughts on our 62nd Reunion might include the tribute honoring MIT Alumni/ae who lost their lives in serving our country in World War II. The "fly-by" of

vintage planes up and down the Charles River was arranged for our view as we stood behind the Kresge Auditorium just before the Technology Day luncheon. After the luncheon, there was a panel discussion at the Stratton

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home town of Barrington, R.I., and she is much appreciative. . . . The Alumni/ae Office has just received word of the death of Ed Sieminski in May 1993. Ed was a graduate of Course VI-C, and died in Fullerton, Calif., where he and Felicia had moved to be near his son and three grandchildren. Ed's major employer was Grumman Aerospace on Long Island, N.Y. He worked in research and development of radar, antennas, color TV, missile systems, and aircraft and space avionics. Besides Grumman, he also worked at Sylvania in Boston and New York, American Machine & Foundry in Connecticut, Fairchild Camera & Instrument, and Amy, Aceves, and King Consultants in New York. He was a member of the National Society of Professional Engineers, IEEE, Radio Club of America, Sigma Xi, American Radio Relay League, and Association for Cardio-Vascular Therapies.

A letter from Ray Kenney who graduated with us in Course XV although he entered Tech as a member of the Class of '33. Ray retired in 1973 from NASA. He now lives three miles from Newport News Shipyard and expresses the need, facetiously we believe, for another aircraft carrier. He has a 3/4-acre garden. A handyman takes care of it and supplies the Kenneys with loads of vegetables. Ray always had a great sense of humor which he has not lost. He is 85 and still full of vim and vigor. He mentions that he has two lots at Ponta Gorda, Fla., one on a paved road, the other on a waterway which he will sell cheaply at the assessed value. He never goes to Florida. Also, Ray tells interesting anecdotes about Pierre Du Pont who was a classmate of his in the Class of '33. When Pete came to MIT, he arrived with a five-passenger Buick convertible. Pete got two traffic tickets and when his father learned of this, he appeared at the Deke house before Thanksgiving to have dinner with Pete. He took the car away and capped Pete's source of cash. Pete was fed, housed, and clothed, but had no cash flow. Pete once stopped at the table in the Engine Room where Ray was studying to borrow 20 cents for car fare to visit his girlfriend on Beacon Hill. Two weeks later he was back with a new pair of Florsheim shoes to sell as he needed some cash to buy some perfume for his girlfriend. He sold the shoes for \$3. Ray said he was wearing Tom McAns that went for \$4.50. When Pete graduated he worked on an ore pile for a year before being allowed to enter management. He eventually became head of Du Pont. . . . President John Hrones was with us at Alumni/ae Day in May and tells the following amusing anecdote. As you know, he spends his summers in Jaffrey, N.H. His permanent home is in Sarasota, Fla. John tells me that he has duplicates of all his clothes in New Hampshire and Florida. The only garment that is not duplicated is his MIT 50th Reunion Cardinal jacket. Since he is able to travel between Florida and New Hampshire with no luggage, and since he needed the jacket for Alumni/ae Day, he wore it up on the plane. His son who is a graduate of Harvard met him at the plane and took him to dinner at the Harvard Club. The waitress commented on his beautiful jacket, and he told her that it was an MIT jacket. She hesitated a moment, then said: "Oh, that's where all the smart boys and girls go and the others go to Harvard!" . . . The Great class of 1934 was not too well represented at Alumni/ae Day: Mary and Russ

Hastings, Gudron and George Gahm, Rose Miller, John Hrones, and Mollie and Carl Wilson. At Alumni/ae Day we learned that MIT is the fourth ranking university in the country after Harvard, Yale, and Princeton. The Sloan School was rated the top business school in the country by U.S. News & World Report.

We still have the target of hearing from 12 class members every month so start writing!—Carl H. Wilson, secretary, 1820 Avenida del Mundo, #309, Coronado, CA 92118-3014

35

John S. Holley writes from his home in Chula Vista, Calif., "Hi Guys: in spite of evil winds in a helter-skelter blow, I'm still kicking. You've read, probably, that the doctors are

now relying on medication rather than surgery in order to preserve life. In my case there is not much to surge, so I'm a pill freak. Oh I can walk—a little. I have a cane and a driver's license. Best of all, I have a terrific wife, children, grandchildren, and great-grandchildren to cheer me on." He goes on to commend my job as class secretary for the last 35 years. The Alumni/ae Association took care of that by presenting me with the Lobdell Award in 1991.

We celebrate the lives of two more of our classmates: William Lacy Root, who died on July 27, 1994, and Chester E. Bond, who died on January 1, 1995. Bill Root was a Course X man and died at his home in Yarmouth, Maine. His major work was in plastics with GE, Raytheon, and Textron. He is survived by his widow, Barbara, in Yarmouth, Maine; a son in Concord, Mass.; a daughter in Wamouth, Maine; and two grandchildren. Chet Bond was a Course XV man and died at his home in Sun City, Calif. His major activity was as a general contractor, and he was treasurer of the Bond Bros, Inc. of Everett, Mass. He was also a director of the Malden Trust Co. He helped to start the Neilson Ratings. He is survived by his wife, Dorothy, two sons, two daughters, and two granddaughters. I am sending condolences to surviving family members.

There are still a substantial number of you whom I have never heard from since 1935. Do not feel it is necessary to write about any exotic trips or activities. Your classmates want to know where you are, how your health is, and if you get out and do some walking or use a wheelchair, and what have you been reading lately. If you can't write or type, give me a call on the phone right now.—Allan Q. Mowatt, secretary, 715 N. Broadway, #256 (I am moving across the hall), Escondido, CA 92025; (619) 432-6446

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60th Reunion

Class President Alice Hunter Kimball has arranged the printing of a current class directory that should be in your hands by early 1996. Will you please use it to call a classmate friend and agree with each other to meet at our 60th Reunion? Assistant Secretary Pat Patterson and I would like to visit at reunion the surviving 130 of those with whom we have had personal contacts—but even more

so, those we have not yet reached, including a number within easy motoring distance to Cambridge. Now is a good time to plan ahead, and write of reuniting on your year-end greeting cards to classmates. Best wishes for happy holidays from your class officers, including **Ken Arnold**, VP, **Eli Grossman**, treasurer (since 1951!), and **Fred Assmann**, class agent.

Some readers of last issue may have questioned the description of the Allison V-12 engine as "a very reliable second winner." And indeed it was not initially, at high altitude, because Army Air Force peacetime specifications had anticipated low-altitude use. My source is a recent bridge partner, who had been with a photo-reconnaissance unit using P-38 Lightnings in C-B-I. The B-17 "Flying Fortresses," bristling with machine guns, would not need fighter escort as they bombed from high altitudes with the Norden bomb-sight. The rude awakenings of actual combat in the Pacific culminated in the 1943 raids on Regensburg and Schweinfurt, Germany, where entire squadrons of unescorted B-17s were lost. Connie Bouchard redesigned the Allison for the Lightning, and Rolls Merlins were used in the famed P-51 Mustang. My younger brother Edward flew one from England over Poznan, Poland, and Berlin several times.

Jean and **Pete Weinert** stopped at Santa Fe in May on their way to San Diego for the America's Cup races—a calamitous regatta for the USA. In 1992, Phoebe and I saw the Italians nose out the Kiwi's in the challenger sail-offs, but New Zealand is an "island of ocean sailors" on every side. Perhaps their triumph this year was a happening waiting to happen, and it may be years before we win again. In February, the *Barrington Courier-Review* had a feature article on Pete's building "museum-quality models of sailing ships of the past," with excellent pictures that I will bring to reunion. He starts from scratch usually, with wood, brass, and cloth, and fashions even tiny block-and-tackle pulleys, dead-eyes and ratlines, using tweezers often. Much of the time he has to work from drawings and pictures, which he did for the 1976 ship *Raven*, a Christmas gift to his daughter-in-law. Her great-great-grandfather was its skipper. Pete has given up distance sailing—transAtlantic, Chicago to Mackinac Island (14 times) and the 100-mile 5.5 (36' Championship). He says "sailors start with little boats, get bigger ones—then getting older, smaller and smaller boats."

Canvass returns: **Ed Halfmann** (Course VI-A) retired as director of research with Philadelphia Electric in 1979, and in 1986 moved to a new home in Bloomsburg that he and wife Dorothy designed. Never idle, he has taken courses at Bloomsburg University, taught in the Literacy Program, and is active in Rotary and the amateur radio club. All this in spite of five bypasses and trouble with cancer. They winter at Hilton Head but had gone north before the meeting with **Harry Hazelton**, **Marshall Holcombe**, and **Tom Nelligan**. . . . **Stanley Freeman** (Course VII) is "retired but in excellent health," and enjoys tennis, golf, and thoroughbred racing. After World War II service in the Navy (lieutenant commander) he was West Coast VP of Witco Chemical Corp. until 1960, then president of Greentree Electronics in Los Angeles, and finally chairman of Electronic Arrays, Inc.

After MIT Stan got an MS at the University of Massachusetts.

The mailing to our quiet classmates is about two-thirds completed, and results to date are somewhat disquieting: returns after each group mailing have slimmed, yet only a few letters were returned "no forwarding address" and a few death notices received from families. To all readers, quiet or not, please ask your families to include the MIT Alumni/ae Association, 77 Massachusetts Ave., Cambridge, MA 02139 in notifications, with a news clipping if available. We don't want anyone to fade away, without a tribute in this column.

Cheers for the lives of **Hawthorne "Harry" Brown** (Course XV) and **William Prudente** (Course I)! Harry died last June 6 after a long illness. He was sales director of Ensign Products Co., and had been in engineering at GE/Schenectady. In retirement he did volunteer work for South Shore Elder Services, and was a sailing enthusiast, out of Hingham. . . . Bill Prudente's 50th biography was brief, but he attended the Reunion (11th from left in the seated row), and during my 1991 visit told of his experience with Stone and Webster in nuclear-power-plant construction (Feb/Mar 1992 issue). The media hysterics over Three Mile Island in 1979 were extreme and diserving, and we both deplored the hurtful effect on public perceptions.—**Frank L. Phillips**, secretary, 1105 Calle Catalina, Santa Fe, NM 87501; tel: (505) 988-2745; **James F. Patterson**, assistant secretary, 170 Broadway, Pleasantville, NY 10570; tel: (914) 769-4171

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We kick off with an interesting letter from **Norm Birch**. He urges **Rose** and **Bob Thorson** to "go when you want to, and do what you would like to," cautiously adding "with-in reason, of course." Not a bad suggestion for all of us at this point. Norm had just finished his and Elvie's first full summer in Florida and found that, with reliable air conditioning, it is very comfortable "even in our 90- to 95-degree days." They exercised, swam, walked, and attended some Elderhostels. . . . **David Tuttle**, ex-professor of electrical engineering at Stanford University, has a somewhat different feeling—that both he and his wife Becky are spending too much time dealing with health problems. Nevertheless, he admits to "tinkering with differential equations on my Macintosh" and to celebrating his 61st reunion at Amherst where he was class of '34. . . . Then there is **Holden L'Ecluse**, who used to own and run a motel. He still does some condo management, but manages to travel. He and his wife, Muriel, spent a month in Europe in 1990. They took in the Passion Play at Oberammergau. Having celebrated their 50th anniversary, they try to take a cruise every year. Otherwise, they have several grandchildren and one great-grandson to keep them busy.

No retirement for **Ralph Chapin**. He is chief executive and treasurer of the R.E. Chapin Manufacturing Co. and recently was honored by receiving a "Turnaround" award for five exciting years spent in reinvigorating the 111-year-old business created by his grandfather. He says "thanks to and with the help of inside managers and outside advisors, we pulled it off and are back on the track with strong new

ClassNotes

management in place." . . . In sharp contrast, **W. Cameron Michell**, of Hampton, Ga., retired more than 25 years ago as president of Southern States, Inc., and spent much time in athletics. Recently, he was inducted into the Atlanta Athletic Club Hall of Fame along with Bobby Jones and several other notable athletes. "My fame came from a long career in tournament badminton in the South. I am in good health and still play badminton and serve on the board of two banks as well as the board of the National Safety Council." . . . **Frances Blackwood Tyler** of La Jolla, Calif., writes that her husband of 52 years, John E. Tyler, '40, died in 1992 of Alzheimer's, but she has four daughters and six grandchildren who keep her busy. She is actively involved with the University Women's group at UCSD. Her favorite hobby is bridge, followed by genealogy, reading, and sewing. No longer homebound—first to care for her elderly mother and then more than eight years to care for her husband—she has been able to travel a bit. She made a trip to Massachusetts and visited an old classmate, **John Gould**, and his wife Marion. The three toured the campus at MIT and she was amazed at the changes that more than 50 years had wrought." (Ed: even those of us who have watched it happen are amazed). She also was impressed with the PBS program she had seen, remembering Robert Woodward who started out as a member of our class, but received his doctorate when we were receiving our bachelor's degrees.

It was good to hear from a classmate who worked on *The Tech* with one of your secretaries. He writes as (**Ralph**) **David Morrison**. (I knew him exclusively as Ralph). He writes about his two-week trip to Scotland—"seeking ancestors' traces"—but does not say whether he found any. However, he does mention three delightful children living in Bucks County, Pa., and New York City. Wish he had filled in some of the blank spaces. . . . We were saddened to learn of the death some time ago of **Jonathan Billings Cobb** who retired from PPG Industries. He lived in New Berlin, Wisc., and is survived by his wife, Eleanor. Hope we shall receive more details.—Co-secretaries: **Leonard A. Seder**, 1010 Waltham St., B345, Lexington, MA 02173; **Robert H. Thorson**, 66 Swan Rd., Winchester, MA 01890

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City of Pacific Grove, Calif., city manager **Michael W. Hare** calls disaster coordinator **Russell Coile**, Pacific Grove's own ambassador to the world of emergency preparedness. *City of Pacific Grove News Notes* reports on the 30-day trip to England of Dr. Coile and wife, Ellen. At the first conference in England, Russell presented a paper and for his work, he was made a Fellow of the Institute of Civil Defense and Disaster Studies. At the second conference—the Emergency Planning Society held in Scarborough, Yorkshire—he was the only lecturer who was honored with a special plaque at a presentation on the final night banquet. While in England, he visited

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different sized jurisdictions to ascertain their level of preparedness.

Back in the U.S., Russell was presented with a certificate of appreciation from the Carmel-by-the-Sea chapter of the American Red Cross for his help as a volunteer amateur radio operator during the March 13, 1995, Carmel River flood. In addition to these activities, Russell serves on the board of the Conflict Resolution and Mediation Center of Montgomery County, Calif., and several boards and committees involving disaster preparedness, and also teaches the Volunteers in Preparedness six-week course for neighborhood disaster volunteers.

Ellen M. Coile is a volunteer mediator and uses her experience as an ATM toastmaster in fund-raising for the Conflict Resolution and Mediating Center. As an impartial third party, this public nonprofit program provides dispute settlement services covering business, consumer/merchant, discrimination and harassment, domestic, environment, family, neighborhood, small claim, tenant-landlord/housing, and youth/school conflicts. The center also provides mediation training. There is no charge for individuals using the community-based program and a lawyer is not required for mediation.

Ed True writes from Searsport, Maine, that he and Millie thoroughly enjoyed the mini-reunion at the Wayside Inn and enclosed an article from the July issue of *Yankee Magazine* which concludes with "We'd met a man who has the remarkable ability to look to the future by way of the past—or something like that. At any rate, we'll wager that future history books about British and American shipbuilding along the North river will say that a certain Lloyd Bergeson, who lived and worked on the river during the latter part of the 20th century, was actually the best shipbuilder of them all." The six-page article is headlined "House for Sale, on the river that launched a thousand ships. When we moseyed down to Norwell, Mass. to inspect a 2 1/2 story 1730 Georgian on the North River, we never expected to meet a man who could very well be in the history books of the 21st century."

The article describes and shows picture of the house of Carol and Lloyd Bergeson, 20 miles southeast of downtown Boston, and states that Lloyd, class of '38 at MIT, is a retired naval architect and shipbuilder. Carol is a trained historian. It gives the history of the house and the area. The article mentions Lloyd's having been involved in the design and construction of the first Polaris missile submarine, the USS *George Washington* at Groton, Conn., and of his being general manager of the Quincy, Mass., shipbuilding division of General Dynamics. It also tells about his 32-day solo voyage in 1978 aboard his 43-foot yawl across the North Atlantic from Maine to Norway; with the exciting sequel of disaster the following year on the return trip with his son, Henry, when they literally fell off a monstrous rogue wave south of Iceland. Forty-eight hours later, adrift and losing the battle to stay afloat, they were rescued by a British container ship.

In the late '70s and early '80s Lloyd founded Wind Ship Development Corp., in his barn and developed easy-to-operate sail-assist rigs and the spin-rig. The article includes pictures of vessels using these fuel-saving devices. These devices will see wider use as fuel costs

increase. In 1986, he completed building his 33-foot sailing yacht *Tore Hand*, and today he continues his interest in sailing.

Along with the returns from the mini-reunion were those expressing regrets but making comments. . . . Dick Henderson had a year of renewal: new lens in the right eye and two new hip joints. Still doing a little consulting in toxicology. . . . Ascher Shapiro retired from MIT in 1986 but remains active as a consultant. . . . David Wright expected to be somewhere in British coastal waters. Warm regards. . . . John H. Craig expects his 10th grandchild on reunion week and expects to see Alice and Roy Hupgood this summer at Wolfboro, N.H. . . . Charles J. Donlon retired from NASA/NACA in 1976 after 38 years. He was consultant for the Institute for Defense Analysis from 1976 to 1989 and member/consultant of the NASA Aerospace Safety Advisory Panel from 1984 to date. In April 1995, Charles received NASA's DSM Public Service Award for his contributions to aerospace safety. . . . Chung C. Wong is still active working a 40-hour week on PRC related business.

Paul O'Connell of Melrose, Mass., died on June 6. After graduation in civil engineering, he did survey and soil lab work before being ordered to active duty in the Army in 1941. After the war, he was a structural building engineer with the Metropolitan Transit Authority. He remained in the Army Reserve-Artillery and retired a lieutenant colonel. Paul and Marie were regular attendees at our reunions. Even though they were aware of Paul's cancer problem, they had planned on attending the June reunion, but didn't quite make it. Ed Hadley writes: "I attended the memorial service on Saturday June 10 at St. Mary's Church in Melrose officiated by both a monsignor and a priest and attended by about 200 people. It was held in the church that Paul had helped design and rebuild. The church, the service, and the music were beautiful. The priest's eulogy was heartwarming and sincerely delivered."

Class president Fred Kolb sends a copy of a letter he wrote to Gretchen Birge of Sunnyvale, Calif., stating in part that he had received her message that she no longer wished to be listed as assistant secretary. The letter continues: "We have been counting on you for an ear and window on the west. Therefore, with reluctance, I accept your request. We appreciate your willingness to serve both this round and in the 1963-73 period when you were also assistant secretary. Thank you very much!" He continues with general class news, a request to send any news she might encounter or develop, and a closing thanks. This means we are on the lookout for an assistant secretary. Please send your class secretary or class president any thoughts you may have on this matter.—Paul R. Des Jardins, secretary, 6251 Old Dominion Dr., Apt. 310, McLean, VA 22101-4807; tel: (703) 534-4813; Frederick J. Kolb, Jr., president, 211 Oakridge Dr., Rochester, NY 14617-2511; tel: (716) 342-3093

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In ceremonies on May 6 to render tribute to MIT's Sustaining Fellows, president Charles M. Vest mentioned their generous support to help MIT shape a better future

through science and engineering. He said the Sustaining Fellows, as a group, gave MIT more than \$265 million to endow faculty chairs, finance academic programs, and lend money to students. The Sustaining Fellows was established in 1979. Of the 1,219 persons who are its leading individual donors, 39 graduated in 1939. . . . **Morrie Nicholson** noted omissions in the July Class Notes listing Sustaining Fellows. Thanks to him, I found I had referred to an obsolete roster for those July notes. To offset the omissions, on July 12 I mailed a 39-name roster of '39er Sustaining Fellows to each classmate whose name had been omitted.

Harold Pope retired as chairman of the board and CEO of Sanders Associates, Inc. During career years, he received many honors, including the MIT Corporation Leadership Award in 1976. The H.W. Pope Scholarships were established by Sanders Associates in 1982, and later extended by Lockheed. In June 1995, Harold participated again in presenting scholarship awards to students with outstanding records in High Schools and Prep Schools. Three of the 1995 awards were named "The H.W. Pope Scholarships" and they were for \$4,500 a year for four years. This year, Harold and Vonnice were especially pleased that a \$1,500 scholarship was awarded to Jeanene N. Pope, granddaughter of '39er classmate **Gordon A. Pope**. Harold and Vonnice attended the MIT Sustaining Fellows Plaque dedication ceremonies and dinner in May at Cambridge. They have kept in close touch with classmate **Walter J. Mykytow** who visits them frequently in Stuart, Fla., Wellfleet, Mass., on Cape Cod, and their home in Amherst, N.H.

Harold writes: "...your mention of MIT brought back many memories. My thesis was under Doc Draper's supervision. I took film footage of an airplane cockpit instrumentation (to document "the northerly turning error of the magnetic compass") while Doc Draper got in some flying time, courtesy of Sperry Gyroscope Co. The lighting for the movie was from a string of automobile headlights powered from the Waco airplane's battery ignition system. The lighting drained the battery and we ended up in a dead-stick landing in the middle of Boston airport where we were towed back to the flight line. Was Doc ever embarrassed! **Walter Mykytow** and **Bill Rieser** were co-authors of the thesis titled, "The Northerly Turning Error of the Magnetic Compass," which was sponsored by the Sperry Gyroscope Co.

"Dr. Otto Koppen was kind enough to let me skip some classes to allow me to get my private pilot's license under a government-sponsored program, with the admonition that I would learn more from that experience than from taking his courses. That, of course, was not true, but I wanted to believe it. **Bill Rieser** also got his license at the same time I did, as did **Paul Sandorff**. Bill was killed in a B-24 crash in San Diego about a year later after a factory worker hooked up the flight controls backwards, so up was down and down was up. Enough of these reminiscences. Regards to you, **Bob Withington**, **John Alexander**, and **Hans Bebie**—Harold . . ."

Class president **Manning Morrill** forwarded news from Elizabeth Garvin, director of class programs. She writes: "Eight students received funding from the Class of 1939 Scholarship

Fund. Four renewal recipients are: **Timothy Dawson**, '95, of E. Rutherford, N.J.; **Farnaz Haghseta**, '96, of St. Louis, Mo.; **Esteban Irigoyen**, '96, of El Paso, Tex.; and **Peter Tsang**, '95, of Queens, N.Y. Four new recipients include: **Nestor Ashberry**, '96, of Mission, Tex.; **Jihun Oh**, '96, of Lenexa, Kans.; **Abraham Udubot**, '95, Washington, D.C.; and **David Vengerov**, '97, Brooklyn, N.Y.

Also a sophomore from Fairfield, Maine, was selected as the 1994-95 recipient of the **Richard P. Feynman**, '39, Scholarship at MIT. **Christopher Bentzel** chose to major in electrical engineering and computer science. . . . Thank you for the contributions made by you and your classmates towards this fund. The continued generosity of so many alumni/ae allows the Institute to maintain its commitment to these fine students."

Mark Hyman, Jr., and friend attended the May 6 ceremonies for the Sustaining Fellows. Some of Mark's career was with Polaroid. More recently, he collaborated with Professor **Cornelius Hurlburt** to develop and perfect a new instrument to measure high refractive indexes. They seek someone to manufacture and sell it.

Art Zeldin and **Helen** plan to celebrate the 60th anniversary of their wedding on August 18, 1995. Then they'll travel to Zurich to visit their daughter and her husband who are posted there. After touring Northern Italy, they'll return to Silver Spring, Md., where Art will resume control of his brand-new personal computer and its many bells and whistles.

Bob Touzalin and **Aletta** and **Eugenia** and **Fred Cooke** canal-boated in England last summer. Their leased boat was 6'10" wide and about 50 feet long. Bob writes: "We started our trip in the mountains of Wales on Llangollen Canal. This canal has two remarkable aqueducts. The Pontcysyllte aqueduct is over 1,000 feet long and passes 120 feet above the River Dee. The Chick aqueduct is about the same length and it passes 70 feet over the River Cairn. The canal was completed in 1806. The Pontcysyllte aqueduct was built by the great engineer **Thomas Telford**. On it, boats are carried in a cast-iron trough about one foot wider than the 6'10" wide boats. The trough is supported on the top of a row of stone piers. The masonry joints of the stone structure are bonded by a mortar made up of a mixture of lime and ox blood. The dovetailed joints in the iron trough are sealed with a combination of Welsh flannel and lead dipped in boiling sugar. The aqueduct has a towpath fenced off with an iron railing, but the offside is completely unprotected from 12 inches above its water level. Fred and I found we could get a good view of the rivers 70 and 120 feet below by leaning over the side of the boat."

Leo Kiley writes: "Luna and I are still enjoying Santa Fe and the Land of Enchantment. Finally retired for third time: United States Air Force in 1969, General Electric in 1978, and Los Alamos Tech Association last year. We travel some for a week or two at a time, mostly to Arizona and Colorado. Visit Maine and Boston almost every fall for about two weeks. **Sylvia** and **Seymour Sheinkopf** have been our only alumni visitors. If you are around Santa Fe, please give us a call."

The Sheinkopfs continued on toward the Pacific Northwest where we expect to have a mini-reunion about August 10. . . . **Woody**

ClassNotes

Baldwin writes in impressive calligraphy from Torrance, Calif.: "Activities include playing flute in orchestras and ensembles, racing 14-foot sailboat, writing two columns on boat racing (and bizarre and comical events that occur), calligraphy: 1,418 name tags to date, plus dozens of poems, certificates, etc., and publishing proof of math theorem."

Some '39ers with already-executed estate plans still have a few weeks, before about December 20, 1995, to reconfirm they have their most advantageous optimization of two taxes updated and in place. We are nearing age 80 and approaching another year-end. It is timely and prudent to reexamine and reconfirm that our future taxes are optimized, or updated now, if necessary. One tax is on 1995 income. The second tax is payable on the estate remaining after death of the spouse second-to-die. The key objective of reconfirming promptly is to determine what new advantage, if any, can be generated by giving some appreciated property or appreciated securities to MIT before about December 20, 1995. Advice is available from '39ers **Len Mautner** and **Ernie Kaswell** or from **Joe Collins** and **Hugh Darden** at the Alumni/ae Association.

During 1995, eight editions of '39er Class Notes were published. About 21 '39er alumni/ae and 12 spouses were named per edition. About 90 classmates were named during the whole 1995 year. If about 280 classmates are living and if 90 produced news, then about 190, or 68 percent, are our silent majority. In today's notes, about 17 living classmates are named. If each would telephone two persons in our "silent majority" to mail personal and unusual newbits to the secretary, up to 34 extra letters could improve and broaden future Class Notes.

We are saddened by news in the *Patriot Ledger* in Quincy, Mass., of the death of **William M. Chance, Jr.** on May 19, 1995. He worked worldwide as a civil engineer. He served in World War II and was the youngest lieutenant colonel in the Corps of Engineers at the time. In recent years his residence was in Portland, Ore.—**Hal Seykota**, secretary, 2853 Claremont Dr., Tacoma, WA 98407

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Following the 55th Reunion, past president **Norman Kliavans** sent a letter to the class officers and reunion committee with his thanks to all for their cooperation. He also

writes, "The memories of the affair will certainly give me a helpful charge over the next few years. Whatever efforts were put forth were amply rewarded by the participation and reaction of our classmates. After the reunion, Alice and I went up to Maine for a week and then Elderhostel. In July, we will have a visit by one of our daughters-in-law and two little girls. And now Bruce will take over the leadership for the next five years. Good!" . . . Norm goes on to offer suggestions for future activities. He notes that the Alumni/ae Association can provide profiles and ideas of what is reasonable and proper for people of our age. In

addition, **Jim Baird** is chair of the Cardinal and Gray Society and will be of substantial assistance. Referring to off-campus mini-reunions, we can expect support from the Alumni/ae Association staff, but the work must be done by classmates. He suggests tying in with the MIT Club of the area where the mini-reunion takes place.

Incoming class president **Bruce Duffett** wrote with an interesting idea: "One of the things I learned at the reunion was, at least a few class members did not attend because they did not know many of those on the list. To alleviate this situation, I am proposing a communications committee composed of approximately 25 classmates willing to write to five members of the class once a year to promote old friendships which have lain dormant for many years. No meetings—no money request—just an occasional letter. It may not do any good but it is an effort." If you have an opinion about this scheme, please write to either Bruce or me with your thoughts.

Charlie Edwards sends a note, "Sorry you didn't make it to the party. We did have a good time! You could add to the info that we spent four days with Art Covitt, '41, in Sudbury, Mass." Charlie also included a report of other activities: "In May, D.J. and I participated in a one-week MIT Alumni/ae Study Seminar in Ottrott, Alsace, France, followed by two weeks of ancestor-tracking through France, Wales, and Ireland. We also attended a seminar held in Switzerland last fall, so this is the second of the study seminars we have attended. We have become fans of these events and would be happy to talk to other alums about our experience. We preceded the formal Class Reunion in June by visiting class member **Bob Gould** and wife, Marion, in Mirror Lake, N.H., along with class member **Walt Helmreich** and wife, Mary Margaret."

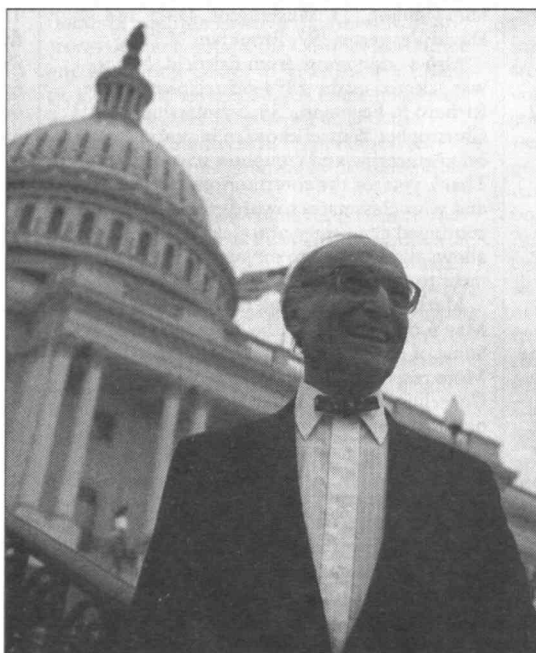
I look forward to your letters and telephone messages.—**Richard E. Gladstone**, secretary, 250 Hammond Pond Pkwy, 1205 S., Chestnut Hill, MA 02167-1528; tel: (617) 969-5161

41 55th Reunion

Larry Turnock has been unusually faithful in keeping the class informed of goings on in the Cleveland, Ohio, area and gleanings from his local press. Several times these have involved our classmate **George White**, because he, like Larry, is a Cleveland native, and a distinguished graduate of the Case Western Reserve University Law School. The latest, a clipping from the magazine section of the *Cleveland Plain Dealer*. Under the banner headline, "CARVED IN STONE," a half-page color photo shows George, resplendent in his trademark bow tie, in front of the U.S. Capitol.

Those of you who have followed his career in these columns, will know from the Nov/Dec '91 issue that George has been the distinguished Architect of the U.S. Capitol, in Washington, D.C., for 25 years. The latest article was occasioned by his announced intention not to seek another 10-year term when his present term expires in November 1995.

This is probably to the liking of Democratic Senators Barbara Mikulski of Maryland and Carol Mosely-Braun of Illinois, who criticize his office's minority-hiring practices, largely inherited from his predecessors. Senators John Warner, (R.-Va.), and Daniel Patrick Moyni-



ARCHITECT OF THE CAPITOL
GEORGE WHITE, '41

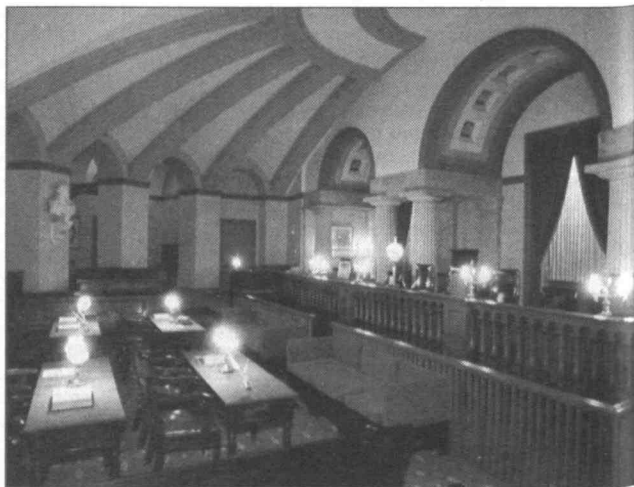
han, (D.-N.Y.), however, defend his distinguished record of achievement. Said Senator Moynihan, "He has been our finest architect since William Thornton (who designed the Capitol). And come to think, the only 'real' architect in this century. No one save he would climb to the top of the dome to check the Statue of Freedom, and no one deserves the freedom of the Capitol more than he." Shortly before this tribute in July 1991, a few days before his 71st birthday, without looking down at the ground 28 stories below, George climbed a shaky aluminum ladder to examine the pockmarks and corrosion spots inflicted by 128 years of *Miss Freedom's* exposure to the elements. This feat was to verify plans for the \$750,000 refurbishment of the statue. Most of Washington missed the dramatic event, but turned out in force, a few days later, to see a flying crane helicopter lower the heavy goddess to the ground. Several local classmates would have paid good money to view George's then unpublicized climb!

During his 25 years, George directed many controversial and politically sensitive projects with engineering know-how and artistic taste: repair of the Capitol west front, discovery and refurbishment of the original Supreme Court chamber, and renovation and rearrange-

ment of Statuary Hall. Major buildings constructed include: the James Madison Memorial, the third building of the Library of Congress, and the \$138 million Philip A. Harte Senate Office Building. The latter features an inner court with a controversial, modern work of art, *Mountains and Clouds*, by famed American sculptor Alexander Calder whose mobile, 4,300 pound, clouds hangs 70 feet above the floor. Window washers demanded "hazardous duty pay" to keep them clean! White's final major project was the design and construction of the Thurgood Marshall Federal Judiciary Building. *Architecture* magazine gave it a glowing review.

As he leaves government (not to retire, he insists), a \$100 million visitors' center, to be built under the east plaza of the Capitol, is on the drawing board. In the underground center, instead of standing in line in Washington heat and snow, tourists will get a history of the building and Congress before entering the Capitol. George may miss the thrill of directing one more major project, but it is a certain he will not regret leaving his 535 House and Senate bosses. Given his addiction for work, Congress may yet see him as a consultant!

As mentioned in the October notes, **Ed Sherburn** sent a long, interesting letter not received in time to include in those notes. Ed was in Course XVIII, mathematics, at Tech, a member of the Fencing Team, the MITAA, and Advanced ROTC Engineers. He writes, "In World War II, I served in the Army Corps of Engineers, and ended up as head of engineer technical intelligence in the European Theater, where we were principally interested in the new developments in German land mines and booby traps. After the war, I started in advertising research at Young and Rubicam in New York, and then went into commercial TV (Dumont Network). This was in the early days, when cameras needed so much light that a candle in the studio could melt from the heat. I worked next for the Navy in instructional TV research, the program that convinced the FCC that TV could teach, and resulted in channels being set aside for educational purposes. In 1955, I went into educa-



THE ORIGINAL SUPREME COURT, REFURBISHED BY WHITE

tional TV, helping start KETC in St. Louis, and putting WGBH on the air as its first director of programs. Later I served as statewide coordinator of educational TV for the University of California, involving both on-campus and broadcast programs.

"In 1961, I deserted both TV and California, joining the American Association for the Advancement of Science in Washington, D.C., to start an activity to increase public understanding of science. This involved everything from science seminars for congressmen to being science coordinator of the U.S. exhibit at the Seattle World's Fair. In 1966, I became president of Science Service, a nonprofit that publishes *Science News*, a weekly with 240,000 circulation. Science Service runs like a business, and I hate to say it, but the biggest contribution that MIT made to my success was two accounting courses (I had a minor in business administration). Knowing the value of pi to 10 places was of no help at all! Science Service also administers the Westinghouse Science Talent Search, which identifies high school seniors with scientific talent on the basis of the quality of independent research projects they have done. The finalists in the WSTS, over its 50-year history have gone on to win five Nobel Prizes, two Field Medals, and eight MacArthur Fellowships. Incidentally, MIT is one of the favorite college choices of the finalists. I retired in 1991, and am now working on a monograph for the National Research Center for the Gifted and Talented. The subject not surprisingly, is 'Precollege Science Competitions.' I am married to the former Mary Lela Grimes, one of the first stars of educational TV, and who won the Sylvania Award the same year as Edward R. Murrow and Dina Shore, for her natural-science program, *Discovery*, on WGBH-TV. We have one son, who is with the Uniformed Services University of Health Sciences near Washington, and is also chief of the Bethesda Chevy Chase Rescue Squad, one of the largest and best in the country." **Chet Hasert** and I met Ed for lunch in August. He is even more interesting in person!

So far only one classmate has taken advantage of my e-mail address to provide news. **Bob Smith** e-mails, "Like you, I have recently gone online (partly to communicate with my granddaughter in California). I am on line with CompuServe, and my address is: <75332.2306@compuserve.com>. By way of class news the '41 members of Phi Delta Theta held a mini-reunion at the Marriott Hotel in Newton last October (1994). Attending were Peggy Sanderson, wife of **Paul Sanderson** (deceased), Penny and Lew Fyske, Marie and **Edgar Hayes**, **John Macleod**, and **Eleanore** and **Bob Smith**. A highlight of the affair was a visit to the Fraternity House at 97 Bay State Rd. While standing around the living room chatting, we were introduced to each new undergrad as he came down from the upper floors. The expression on their faces was a scream: 'You're from the class of FORTY ONE?' I was beginning to feel like we just came in from Jurassic Park! Glad Chet is recovered from his hip operation. We need all the crew men we can get at the 55th!" (Bob was one of the hearties in boat two at the 50th and rowed Number 5 in the dedication row of the **Charles S. Butt, Jr.**, '41 shell last April.)

Nat Rochester passes on the sad news that

Ralph Benjamin Delano, Jr., died of cancer on July 23, 1995. Because this news is so recent, the obituary will appear in the January 1996 issue. His classmates extend their sympathy to his wife **Connie**, who continues to reside at 543 Almar Dr., Punta Gorda, FL 33950. . . . News from **Larry Turnock** is not always upbeat. His latest: **Howard A. Morrison, Jr.**, called to say that his wife passed away on July 21, 1995. We all express our sympathy to **Howard**, who has partially recovered from the stroke he suffered a year and a half ago and is living with his daughter.—**Charles H. King, Jr.**, secretary, 7509 Sebago Rd., Bethesda, MD, 20817-4839; e-mail: <olspace@aol.com>

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Chuck Estes has been tutoring two Mexican students in reading and writing. One passed his citizenship exam several months ago, the other is still trying. **Bernie Levers** writes:

"In June we attended a 50th anniversary party for **Pearl and Al Mall** given by their daughter in Connecticut. I heard from **Irv Kotliar** who could not attend but reports that he is fine.

"**Zelda** and I sailed on two segments of the World Cruise of the Royal Viking *Sun* in March, visiting Burma, India, Vietnam, Singapore, Thailand, Malaysia, and Hong Kong, among other ports. incidentally, I teamed up with an 85-year-old British lady and won at duplicate bridge several times.

"Saigon was a changed city from 1991 when we spent a week in Vietnam on a trip that included four days in Siem Reap, Cambodia, where we toured Angkor Wat under armed guard. Pol Pot's forces were 40 miles away, and one morning we woke to view captured weapons—the result of a battle the night before. Phnom Penh was very interesting as was Laos.

"Also in 1991 we traveled on the Karakoram Highway in the extreme northeastern section of Pakistan, a part of the world I had longed to visit. After years of dangerous toil, 20,000 Chinese and Pakistanis built this road linking the two countries through the mountains. The areas—like Swat and Peshawar where we viewed the Khyber Pass—were fascinating.

"After the last reunion **Lou Stouse** traveled to New Orleans to escort **Zelda** and me around his old hometown. He made the trip from Winston Salem especially to ensure that our stay would be hosted properly. A wonderful ending to our short trip on the *Mississippi Queen* and Copper Canyon in Mexico!

"About a year ago, we moved into a home I built in Cresskill, N.J., a suburban town about eight miles north of the George Washington Bridge. The house is situated on a hill overlooking the Ramapo Mountains on the site of a former golf course. We are thoroughly enjoying our new home, and are keeping well occupied with six grandchildren. I spend some time presenting slide shows of our travels to senior citizen groups and have stayed in shape by working out at a local gym three times a week. We've just returned from a two-week trip to the Canadian Rockies and our Northwest and still believe this scenery surpasses any to be found elsewhere in the world."—**Ken Rosett**, secretary, 2222 Americus Blvd., N., #12, Clearwater, FL 34623

ClassNotes

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All other news sources having failed, I queried **Jim McDonough** by phone to get at least one item for the Class Notes. Last spring **Jim's** family had a reunion at "The

Farm," with children and grandchildren from far and wide bouncing in the hay. **Jim** reports that Tech Day in June was a huge success, featuring beautiful weather, great speakers, and a spectacular flyover of military aircraft. It was also an occasion to meet with **Ralph Leader** and discuss plans for the next class reunion. Both **Jim** and **Ralph** agree that someone else should chair the reunion committee. After years of service, **Jim** is retiring from the Tech Day Committee, and is slated to receive a Bronze Beaver at the AOC in September. At the end of August **Jim** and **Roz** are off to Scotland to validate **Jim's** wearing of the McD kilt on state occasions.

In July your secretary stood in line for one and a half hours at the Chicago Art Institute to view an exhibit of 159 paintings by **Claude Monet**. It was impressive and exhausting, and at this writing I have seen all I want of **Claude's** lily pond at Giverny.

It's too bad when all the news has to come from the president and secretary. Surely some of you out there are doing something newsworthy.—**Bob Rorschach**, secretary, 4727 S. Lewis Pl., Tulsa, OK 74105-5138

44

What a difference a year makes. At Technology Day 1994, there were several hundred '44 classmates and spouses present. Tech Day 1995 there were just 13 of us.

A lucky number? **Anita** and **Les Brindis**, **Frank Chin**, **Mary** and **Bob Clarke**, **Lou Demarkles**, **Warren Grosjean**, **Norm Sebell**, **Bob Smith**, **Melissa Teixeira**, **John Taft**, and **Ruth** and **Louis Zirin**. . . . **John Hull** sends word that **Andrew "Butch" Buccini** passed away on April 2, 1995. **John** learned of this in talking to **Mary Barbara**, **Butch's** wife of 45 years. **Butch** was going strong until late last year when he developed an incurable liver problem. He passed away at home. He is survived by two children, **Bob** and **Nancy**. **Butch** grew up in New Britain, Conn., and was **John's** roommate in the freshman year in the dorms as well as classmate in course XVI. Both were oarsmen. Both enjoyed V-12 before and after graduation. **Butch** did his service in the States, then worked as a sales engineer for a couple of bakery machinery manufacturers—**Baker-Perkins** and then **AMF Bakery Division**. He lived in Naperville, Ill., for many years, then retired to Richmond, Va., and more recently to 9005 Coralberry Pl., Richmond, VA 23229. He was highly esteemed by his business colleagues as well by his community and church. The Class extends its sympathy to his family. . . . **John** and **Buz** moved into a brand new shore house in February (mostly weekends) as they are in their condo near the plant during the week. Their sailboat is tied up at the back door ready for day sailing and mini-cruising. They

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are just back (early July) from a couple of weeks in Holland where John gives a few lectures twice a year. They got great R&R while there and were joined by a couple of children with spouses and grandkids—a most enjoyable time for “Nanni and Grandjohnny.”

In a letter to Ed Roos, class president, Beth Garvin, director of class programs, sent a list of the 14 students receiving funding in 1994–95 from the Class of 1944 Scholarship Fund: Kley Achterhof, '96, from Inwood, Iowa, in management; Shawn Atlow, '97, from Hawthorne, Calif., in mechanical engineering; Benjamin Calderon, '96, from Stockton, Calif., in mechanical engineering; Marc Carlin, '96, from Baltimore, Md., in electrical engineering and computer science; Danielle Coffing, '96, from Noblesville, Ind., in electrical engineering and computer science; Naresh Desiredi, '96, from Austin, Tex., in chemical engineering; Xiang D. Dong, '95, from Brooklyn, N.Y., in chemical engineering; Ruth Lim, '95, from Scarborough, Ontario, Canada, in nuclear engineering; Brian Robertson, '95, from Fenelon Falls, Ontario, Canada, in electrical engineering and computer science; Anna Sokolinski, '96, from Moscow, now a permanent U.S. resident, in economics; Marcelo Targino, '96, from Naperville, Ill., in architecture; Ann Torres, '96, from Baltimore, Md., in mechanical engineering; Sara Yu, '96, from Naperville, Ill., in chemical engineering; and Alexander Zakharov, '96, from St. Petersburg, Russia (renewal from last year), in electrical engineering and computer engineering. I'm sorry we do not have more details on each student's activities.

One of the main celebrations of Technology Day 1995 was commemorating the end of World War II. A beautiful fly-over (three times up and down the Charles River) by about a dozen World War II vintage aircraft was the highlight of the day. Ed Roos had suggested that the class veterans wear their campaign ribbons and medals on their red jackets. In keeping with his request, some of us had them on as well as our service insignia. This was picked up by one of the Institute staff and it may become a regular thing for the vanishing breed of World War II warriors.—Co-secretaries: Frank K. Chin, 221 St. Paul St., Brookline, MA 02146; Louis R. Demarkles, 77 Circuit Ave., Hyannis, MA 02601

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It is hard to believe that we shall be wishing you holiday greetings as we pen these notes on a hot, sultry, foggy day in late July. Far better

that I be off sailing in

downeast Maine—as I shall be tomorrow.

Again, on behalf of your 50th Reunion Committee and your fellow classmates, thank you for being part of our fabulous 50th. Just received the following data from the Alumni/ae Office: Our 50th Year Gift to the Institute was a most impressive \$4,094,832 with 66 percent of the class participating in this reunion gift effort. 57 percent participated in fiscal 94-95.

We broke the Class of '44's 50th Reunion attendance record for percent of the class returning—90 members which equate to 33 percent of the class.

One does not require a PhD in math to realize that the Institute carries our class role call to

be 270, which includes all known living alumni/ae. On the other hand, our so-called active list—i.e., graduates or individuals that have shown a continuing interest throughout the years—would be about 200, which makes these figures even more impressive. Well done, gang!

Many of you—particularly Phil Pocock—have been forwarding 50th Reunion photos. Please keep them coming as Bob Maglathlen will be cataloging same for your review at our 55th in the year 2000. My, but we are a photogenic lot. Should any of you non-Reunion attendees want a copy of our 50th Reunion Yearbook, please let Bob Maglathlen know and he will send you one at an appropriate price. We have a half a dozen books available on a first come basis. Bob's address is: 601 Grove St., Norwell, MA 02061.

Mary Trageser advises that Jim Hoaglund's widow, Mary, married Blair Vedder in Sheridan, Ill., on June 10. Now we know why Mary did not join us for our 50th.

Let's hear from you!—Clinton H. Springer, secretary, P.O. Box 288, New Castle, NH 03854

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50th Reunion

Twenty-eight of our class members attended the June, 1995, Technology Week.

Twenty of these people attended the Navy V-12 dinner dance on campus.

Bob Hoffman chaired a June 16th meeting of our 50th Reunion Committee. On campus activities are planned for June 6 to June 9 to include a Pops Concert, the Commencement Procession, and Technology Day. From June 9 to June 11, we will be in beautiful Newport, R.I., at the Doubletree Hotel on the harbor.

John Maynard and Dan Cooper write that they are very busy assembling our 50th Reunion Yearbook. They would particularly welcome responses from all living class members. Send good quality pictures and general memorabilia to John at 178 Meadow Way, Palm Beach Gardens, FL 33418. Dan is at 15 South Orange Ave., South Orange, NJ 07079. Pictures from our 5th and 10th Reunions would be very appreciated.

Don Burke writes from St. Petersburg, Fla., that after a decade in production management with a hosiery and garment manufacturer and a quarter century in public finance that he is starting a third career writing morality plays. . .

Glen Dorflinger has been selected to serve on the MIT Alumni/ae Association board of directors to represent District 9, which extends from Panama to Canada. . . Russ Dostal writes from Lakewood, Ohio, that he and Mary have ten children and eight grandchildren. Russ retired in 1993 and later received an implantable cardioverter defibrillator, to monitor his heart beat.

John Sullivan divides his time between Houston and Cape Cod. He recently visited Leroy Harrington in El Paso, Tex. . . Bob Wentsch writes from Solon, Ohio, that he retired in 1990 from the Cleveland Pneumatic Co. Bob has been active with Gideons International, which distributed 40 million bibles in 1994. In Cleveland, he drives radiation patients to their treatment locations.

During the MIT 1994-1995 year, eight undergraduates received substantial scholar-

ship assistance made possible by gifts from members of our class. Earlier this year several of our class members had dinner with most of these students.—**Ned Tebbetts**, secretary, 9 Jerusalem Rd. Dr., Cohasset, MA 02025; tel: (617) 383-1662

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Please send news for this column to:
R.E. (Bob) McBride, secretary, 1511 E. Northcrest Dr. Highlands Ranch, CO 80126

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Ken Brock sends a note about his activities for the past year. Ken completed his one-year term as chairman of the Cape Cod Commission and will continue as a member. The commission has regulatory responsibility and has members from many of the Cape's towns. In a referendum vote last year, a clear majority of the voters favored the commission's approach to maintaining a reasonable pace for development. Ken was recognized for helping to defend the tradition and natural beauty of the Cape's life and wealth. With a different objective, some people have joined the Cape Cod Economic Council that favors more economic development. When Ken became chairman, tensions between the two groups had been rising. Ken succeeded in creating a much calmer atmosphere, but the differences in objectives still remains. The *Cape Cod Times* describes Ken's term as a tumultuous year, and they endorse Ken's continued role.

Ken has two new jobs. He is chair of a campaign to renovate his church in Wellfleet, the first campaign in its 275 years! Also, he is working on a campaign for the Cape Cod Hospital. Ken's summary: "I may be crazy, but it beats shuffleboard!"

Francis Callahan is president of Swagelok Companies. Under his leadership at Swagelok, acquisitions were made and the company grew from 150 to over 2,000 employees. He holds 15 patents on products he designed. Recently, John Carroll University awarded Francis an Honorary Doctor of Laws degree.

MIT used the Class of 1948 Student Financial Aid Fund for funding five students. Three students are renewals from last year and two are first-time recipients. Marc Carlin, '96, from Baltimore is an electrical engineering and computer science major. He rowed for the varsity crew. Anthony Ives, '96, from Waterloo, Iowa, is majoring in urban studies and planning and has a nearly perfect cumulative average. He took part in two UROP research projects. Yulan Liao, '96, from San Francisco, is a chemical engineering major. She completed a UROP project about genes.

First-time recipients are Stephen Schleuter, '96, and Marcelo Targino, '96. Stephen is from Olympia, Wash., and is an electrical engineering and computer science major. He played varsity hockey and is house manager of his frat, Nu Delta. Marcelo is from St. Petersburg, Fla., and is an architecture major. He was a member of the varsity track and field team. He volunteered as a teacher in a Cambridge elementary school, assisting with the science program.—**Marty Billett**, secretary, 16 Greenwood Ave., Barrington, RI 02806; tel: (401) 245-8963

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Some people believe that the problems of war, crime, pollution, poverty, famine, pestilence, extinction of species and habitat, etc., would be greatly reduced were it not for the fact that too many people are struggling to live on a globe whose resources are limited. As director of Population Communications International, an affiliate of the United Nations, **A. Sheffer Lang** is one of the very few trying to educate people as to the need to put an end to the population explosion underlying the world's ills. We wish him success.

In Doris Kearns Goodwin's magnificent book, *No Ordinary Time*, she gives an explanation of the operation and benefits of the GI Bill of Rights on pages 512-513. Especially relevant to our class is the following comment: "Exceeding all expectations, the GIs would do exceptionally well at school. A *Fortune* survey of the Class of '49, 70 percent of whom were veterans, concluded it was 'the best...the most mature...the most responsible, the most self-disciplined group of college students in history.'"

The 1949 Tech Show recap contained in my August/September 1995 column prompted an enthusiastic comment from **John Kunstadter**. John urged that anyone having a useful recollection of the show call Ellen Harris, MIT's Provost for the Arts, at (617) 253-5882. She is working hard to ensure that a medley from the show be played by the Boston Pops at our 50th Reunion in 1999. Harris is the newly-appointed Class of 1949 Professor. John Kunstadter played the part of a South American in the Tech Show of 1949. More recently, he received the Bronze Beaver, the highest honor the Alumni Association can bestow upon any of its members.

From an obituary in a Fairfax, Va., newspaper, we learn that Rear Admiral **Harvey Lyon** died of a heart attack on March 27, 1995, at his home in Fairfax. Admiral Lyon was in the Navy for 35 years, largely on submarines, and his service included assignments in the Pacific during World War II and the Korean War. Following his retirement from the Trident systems office of the Naval Sea Systems office of the Naval Sea Systems Command in 1981, he was director of the office of nuclear reactor safeguards and security at the Department of Energy and director of Navy programs with the engineering company of Consultants and Designers, Inc. He retired in 1992. He attended the University of Nebraska and was a graduate of the U.S. Naval Academy. He did graduate work in electrical engineering at the Institute. He received three Legion of Merit decorations and the Meritorious Service Medal. Survivors include his wife of 40 years, Marjorie Walker Lyon of Fairfax; a son, Navy Lieutenant Commander Harvey Channing Lyon of San Francisco, a daughter, Ginger Susan Lyon of Fairfax, and three grandchildren.

A piece of returned mail contains the information that **George Jernakoff** of Loudonville, N.Y., died on April 13, 1995. He is survived by his wife, Nadja. Speaking for the class, I extend our sincere condolences to the families of both men.—**Fletcher Eaton**, secretary, 42 Perry Dr., Needham, MA 02192; tel: (617) 449-1614

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Johnny Appleseed, Move Over

Charles Terrell, '51, has a mission: to reclaim degraded lands. He's well on his way, having planted, with his own hands, more than a million trees—pine, cypress, basswood, cedar, ash, poplar, winged elm, black gum, and others—in Grady County, Ga.

This wasn't the work he prepared for at MIT. "I was 41 years old before I planted my first tree," says Terrell, whose degree is in civil engineering. "I had no idea the world was so plundered." But he was involved in the planning and construction of Lake Seminole in Georgia, and witnessing the extensive destruction of forest land it entailed provoked him to change careers. "I vowed to make

The land was thoroughly depleted when he bought in it 1970—the timber had been completely sold off and the scrub burned. Today, he can harvest trees that he planted himself, culling the stand judiciously and turning a larger profit every year.

Terrell has planted as many as 100,000 of "these babies" in one season. And he cares for them, though, as he notes, "it isn't always a live-happily-ever-after situation. We have fire, drought, disease, and pests, and when we get wiped out, we plant over. I planted one area four times in four years—got a beautiful job on the fourth try."

He feels it's worth it: "When I walk slowly into a forest that I created (that is, God and I), I feel a rapport with the plants and animals that I see there. A doe standing over her reclining fawn threatened me by stamping her front feet and shaking her head. Driving on a back road recently, I saw a

steeply and timber revenue hasn't kept pace. He's willing to stretch his resources, to live with limited return on his investment. But banks accustomed to the return on traditional crops are reluctant to support his projects. "When I try to expound on the economic virtues of tree farming to a banker, in an effort to get a loan, he invariably asks how I manage to get by without food for 12 years!" quips Terrell.

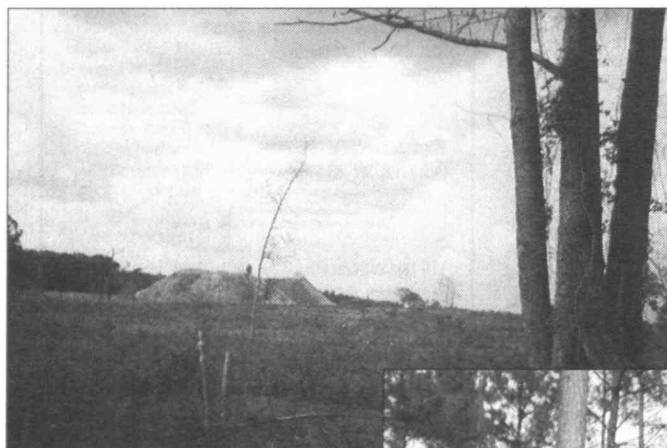
He's also frustrated that he gets so little government support for producing a public benefit—fresh air. Several years ago he was written up in the local paper when he visited the local tax commissioner to protest the newly introduced ad valorem tax on timber, a tax not applied to cotton or cattle farmers. Why should he be penalized instead of rewarded for keeping the landscape green? he asked. "You're breathing my clean air."

The trees, on the other hand, are reliable collaborators, and he has discovered many of their special virtues. The bald cypress, for example, thrives in water; its seedlings will tolerate months of total, constant sub-

mersion and are able to absorb nutrients that find their way into the waterways through erosion. Similarly, a thicket of river birch can be depended on "to create a spectacularly beautiful scene." Terrell has only seen two such thickets in his life, both of which he planted.

"Before I knew better," Terrell says, "I would have judged tree farming as being a very dull operation. No

way!" He has crossed paths with an osprey, a bald eagle, even a panther—and has the satisfaction of knowing he provides their homes or feeding grounds. Sometimes there's more excitement than he needs, like



the world a better place by my having been here."

Over the next decade, he built a wooded empire by investing in land he could sell for profit, then buying land that needed restoration. One measure of his success is the fact that he was able to deed more than 1,000 acres to the University of Georgia School of Forestry. His only stipulation was that the property continue to be operated as a tree farm, open for the enjoyment of the public, but "no paved roads!"



flock of wild turkeys running ahead of me down the road. Then a deer joined the parade. I felt like a proud father watching his children."

Terrell would like to buy more land, but the price of land is rising



the day he had friends hold him over a waterfall by his ankles so he could reach and kill a wild hog with a hunting knife in order to save his dog's life. He's fought wildfires—and sometimes lost, as the flames leapt across his fire breaks and destroyed acres of trees. "Next season, I planted over—that's how nature does it."

Terrell has a formula for happiness, and he's eager to share it. "Find some undeveloped, abused, unloved land. Buy as many acres as you and your bank can carry. Inspect your kingdom minutely: soil type, geology, topography, present flora and fauna. [Consider] what plants and animals might be successfully reintroduced. Walk on it, sit on it, camp on it. Notice how much taller you are here than when you are downtown. Then one day, build your castle. I recommend a small castle, so you can spend more time outdoors." □

—Susanne Fairclough

PHOTOS—Above: Charles Terrell, '51, feeding the fish and a "pet" turtle. **At left:** Looking north from Terrell's land, a strip mine . . . looking south from the same place, 30-year-old slash pines—"some of my oldest children."

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I was fortunate to catch up with Natalie Adelman Taub, who lives in central Massachusetts and is an officer in J. Slotnik Co., a general contractor. Her firm is executing

a \$9 million contract for the Lincoln Elementary School. Natalie has worked for general contractors for many years. This was publicized in the *New England Construction* magazine last fall. The magazine put Natalie on the cover in 1954 with an article about her and her work for a Malden contractor. Last fall they did a retrospective about Natalie showing the 1954 and a 1994 picture (I am sure there was little or no difference) and told of her current activities. Three or four years ago at an AMITA (Association of MIT Alumnae) meeting, Natalie got to see almost all her woman classmates. Natalie did promise to try to join all of us for our 50th. Natalie is married to her first spouse, an internist, and has three children and one grandchild.

Hank Sharp wrote me a long, informative letter that started by chiding me for considering it news that he was *not* coming to reunion (see TR, July 1995). The job is humiliating, Hank, but someone must do it. Hank finished second in his age group in the cross-country skiing half-marathon at Mammoth last April. Next year he moves up an age group, which ought to give him a shot at first. We'll all root for him. Hank ran into Lou Young (see TR, July 1995) many years ago and got him into the Educational Council interviewing candidates for MIT from Los Angeles inner-city high schools. Hank says he heard that Lou did a great job. Hank talks to Milt Rand occasionally. Milt and Jane enjoyed a trip through England and Scotland recently and as of June were off to their cabin in Door County, Wis., not too far from Bud Simpson. Hank reports that Dick Stephan had an abdominal aortic aneurysm early this year. Dick endured nine hours of surgery but is now completely recovered. His doctor told him to "stop and lie down if he gets tired," something Hank cannot picture Dick doing. Hank says Dick "has always gone through life forwardly inclined at about 20 degrees." In June, Hank and Harriet planned to go to San Francisco via Yosemite where he has heard that the falls are more spectacular than any time in the last 100 years. Thanks for all the news, Hank.

Walter Attridge wrote that he is inflicting on his high school class, which is having their 50th reunion, the same confidential questionnaire you received prior to our 45th. . . . Wil Haggerty writes that he is well, happy, and retired after spending more than 30 years in the solid rocket propellant business, the last 22 at the Naval Ordnance Station in Indian Head, Md. Wil had a "silent" heart attack five years ago without any debilitating damage, and he benefited from Bob Mann's efforts when he had an artificial hip implanted three years ago. Wil recommends it to anyone with a hip problem.

Wil sent along some sad news in the form of an obituary for Franklin Charette. Frank died July 21 in Bethesda, Md. A retired Air Force colonel, Frank was a highly decorated combat veteran of the Vietnam War. In 1966 and 1967 he flew 290 combat missions. His decorations are many including the Distinguished Flying Cross, the Bronze Star, and 13 Air Medals. Frank retired from active duty in

ClassNotes

1976. He is survived by his wife of 43 years, the former Mary Ann Zumwalt. . . . I also received the sad news that Charles Park died January 28, 1994, in Rochester, N.Y. He is survived by his wife, Betty.—Robert A. Snedeker, secretary, Seven Mashie Way, North Reading, MA 01864; tel: (508) 664-1738

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45th Reunion

Following his retirement in April 1992, Roger G. Christman has

been enjoying a very active life that includes music, teaching, some consulting work, and visiting his very scattered family consisting of five children and nine grandchildren.

We have received the sad word of the passing of Frank H. Thomas on March 9, 1995. We extend our sincere condolences to his wife, Patricia.—Martin N. Greenfield, secretary, 25 Darrell Dr., Randolph, MA 02368

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Several months ago we mentioned here how Swraj Paul was reopening a steel mill in Pennsylvania that had been bankrupted and closed. He has very kindly sent us a copy

of his remarks at the ceremony last June celebrating the reopening, along with press clippings describing the event. In his talk he relates his origin in a family that ran a metal-working business in a small city in the Punjab. He says he might have remained in India had he not brought his family to England seeking medical treatment for what proved to be the fatal illness of his daughter. Once there, he started with a one-man business that has been built up over 30 years to a world-class operation with sales of around \$800 million and growing. The tragic event that accompanied its inception seems to have given meaning to the subsequent success of his Caparo Group Ltd., which remains very much a family enterprise. At the ceremony he mentioned that he is having a memorial sculpture for his daughter installed this fall at the steel mill, because, as he says, "We live in the present, but the past is always part of our being."

Reunion chairman Stan Sydney wrote to me to plug our 45th Reunion at the Hotel Hershey, Hershey, Pa., next October 25–27, 1996. He says that class dues and commitments to attend are pouring in. Please respond to the invitations to attend if you have not yet done so. As always, a lot of work goes into the preparation of our reunions, and it shows in the results. It should be a wonderful occasion.

The recipient of the Class of 1952 Scholarship last year was Christian Anderson, a sophomore in aeronautics and astronautics, who finished the fall term with a 5.0 cum. He is from Cody, Wyo., and lists sports, racing cars, and high-performance and combat aircraft as his interests, along with photography, pyrotechnics, ice hockey, tennis, and mountain biking. He plans to be an aeronautical engi-

neer. We are reminded that it is our contributions that make the support of outstanding students such as Christian possible.

I was saddened to learn that **Wes Haywood** died May 8, 1994. Wes was the president of our class our freshman and sophomore years. He had been a staff scientist with Raytheon Missile Division. His wife, Estella, survives him. —**Richard F. Lacey**, secretary, 2340 Cowper St., Palo Alto, CA 94301; e-mail: <rlacey52@aol.com>

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Please send news for this column to: **Joseph M. Cahn**, secretary, 20 Ocean Park Blvd., #9, Santa Monica, CA 90405-3557; tel: (310) 396-6322; fax: (310) 553-0687; e-mail: <jmc20@aol.com>

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From Caracas, Venezuela, comes word that **Cesar Quintini-Rosales** has been elected to the board of Baninsa Corp., an organization actively involved in the privatization of the energy and transportation enterprises in Venezuela and other Latin American countries. But we hear nothing from those of you who are much closer than South America. Drop a quick note so that we can keep up-to-date on the class. —**Edwin G. Eigel, Jr.**, secretary, 33 Pepperbush Ln., Fairfield, CT 06430

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Charles Ladd was one of 10 persons elected to honorary membership in the American Society of Civil Engineering in 1995 for "his distinguished career in geotechnical engineering as a teacher, researcher, and practitioner." He is the Edmund K. Turner Professor of Civil and Environmental Engineering at MIT. Charles and his wife, Carol, live in Concord, and have three children and seven grandchildren. . . . **Richard Koehler** recently retired from the position of senior (electrical) engineer after 26 years at the Woods Hole Oceanographic Institution. He now has time to take a few courses in recent technology and to try computer-aided design programs.

After 30 years of law practice in Washington, D.C., and Palo Alto, Calif., **Paul Valentine** has retired from active practice with his firm in Palo Alto to practice exclusively as a mediator and special master in intellectual property and complex business cases in the federal courts in Northern California. Paul and Nancy, who are celebrating 40 years of marriage this year, now live in Sacramento. They have three married children, two grandchildren, and enjoy traveling, theater, music, and glorious summers in the Sierras.

Our former illustrious class president, **Ed Ehrlich** reports that he and his wife, Jan, Polly and **Paul Attridge**, **Trudy** and **Elmer Crouthers**, and **Edie** and **Bob Greene** attended the extended class reunion in Puerto Rico. The trip was organized by **Bob Greene** with travel arrangements made by **Ash Stocker's** wife, **Martha**. They arrived Monday noon following the reunion at the Hyatt Dorado Beach resort and had perfect weather all week. Similar to the 35th extended reunion trip to Bermuda,

the group declared that everyone should do their own thing, and then all did almost everything together. Sightseeing trips were made to old San Juan and the central mountains with Paul acting as chauffeur. Golf, swimming in the ocean and room-side pool, eating, and doing nothing nicely were the main events. Plans are being made for a similar extended trip after our 45th Reunion and it is not too early to submit your suggestions.

Prior to our 40th Reunion **Gil Davidson**, **Phil Brooks**, **Sandy Goldman**, and **Rowe Austin** volunteered to orchestrate the compilation of a book about our classmates. As those that attended the reunion and received a copy of the book can attest, they did a marvelous job. Classmates shared some of their life's experiences and submitted recent pictures that are shown with our graduation pictures. Over the coming months your class secretaries will feature selections from this great work in this column—unless you choose to inundate us with even more current news, in which case we will give you priority.—Co-secretaries: **Roy M. Salzman**, P.O. Box 197, Rockport, ME 04856-0197; **James H. Eacker**, 3619 Folly Quarter Rd., Ellicott City, MD 21042

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40th Reunion

John N. (Nick) Newman is on the faculty in the Department of Ocean Engineering at MIT (until 1970 known as the Department of Naval Architecture and Marine Engineering). Nick had in the past done graduate work at MIT and Cambridge University and then worked until 1967 for the Navy at the David Taylor Model Basin. Nick's teaching and research activities are in the area of "marine hydrodynamics" which is the title he chose for his text published in 1977 by the MIT Press. Nick's specialty is the influence of waves on ships and offshore platforms. Kathy and he spend most of their spare time sailing, which gives John a lot of opportunities to observe waves. The highlight of their sailing activities was a trans-Atlantic cruise, sandwiched around a sabbatical year as visiting professor at the Norwegian

Technical University in Trondheim in 1981–82. Since then Nick has enjoyed continuing contacts with Norwegian colleagues and students, and several of his current research sponsors are from the Norwegian offshore industry. He has three children; son Jim is a graduate of the Class of 1979.—**Ralph Kohl**, co-secretary, 54 Bound Brook Rd., Newton, MA 02161; e-mail: <kohl@ll.mit.edu>

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Please send news for this column to:
John Christian, secretary
7 Union Wharf
Boston, MA 02109

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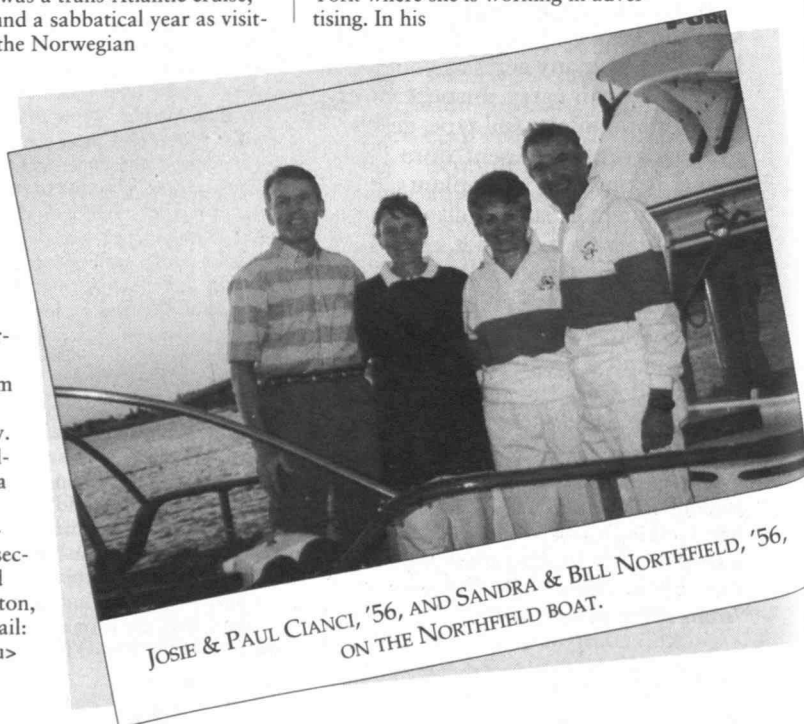
Congratulations to **Martin O'Donnell** whom **Mike Brose** has appointed class VP. He will fill the vacancy caused by the untimely death of **Cole Bess**, as reported in the Octo-

ber column. Marty has been active in a variety of alumni roles including the Educational Council and Humanities Visiting Committee. He also helped to plan a number of class reunions. Marty continues to practice patent law, with most recent focus, not surprisingly, on the computer industry. I don't suppose there is much call for his services regarding slide rules anymore.

Technology Day activities were attended by a number of '58ers, including **Fred Fisher**, **Mike Brose**, **Toni Schuman**, **Liz Drake**, **Glenn Strehle**, and **Marty O'Donnell**. If our spotters missed any other classmates, just send me a note that you were there (plus other info for this column) and it will appear in a future issue.

Dave Rosen is now a consultant in manufacturing technology, providing his clients the expertise developed in his 15 years as director of engineering at Kendall Healthcare Products Co. In this role, he supervised start-ups and worldwide operations in the U.S., Japan, Belgium, Thailand, Mexico, and China. Lots of frequent flyer miles! Before joining Kendall, Dave worked at the Dewey and Almy Division of W.R. Grace where his international responsibilities took him to France. This was his first position after receiving SB and SM degrees in Course X.

Dave and wife **Krana** are in the process of transitioning from family homestead to condominium. Son **Steven** and his wife recently moved from New York to Boston where he is working as a financial analyst. Daughter **Allison** maintains the family presence in New York where she is working in advertising. In his



JOSIE & PAUL CIANCI, '56, AND **SANDRA & BILL NORTHFIELD**, '56,
ON THE NORTHFIELD BOAT.

spare time, Dave alternates between tennis and golf. In addition he and Krana are the best source we know for the first word about great new restaurants in Boston and eastern Massachusetts!

Please send news to Gary Fallick, secretary, 4 Diehl Rd., Lexington, MA 02173

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An update of life changes "for what it's worth" comes from Ron Wiley. Ron reports that between himself and spouse Judy there are 9 children and 15 grandchildren ("+ more in process"), and that the oldest grandson goes to college this fall on full scholarship (this may be a class first!). "Sailboat racing has been my main avocation for 20 years—have qualified for and raced in four Hobie national competitions. Ron sold his Hobie 17 before moving to Michigan (water too cold) but hopes to get a J-22 for next summer. Ron now works as scientific director of LexaLite Scientific Center, a new position for him after nine years with Opto Mechanik as VP for technology. He says LexaLite is "a nice bunch of people, nice place to live, and no military or government work." He has always worked in optics, telescopes, missile guidance and tracking, etc., and, more recently, has concentrated in the field of optical coatings. "I have been somewhat known in the international coating community for my practical applications and empirical insights on how coatings work and should be designed." Ron's teaching and technical-conference travel has allowed him to fulfill the goal of seeing many of the interesting places in the world. Ron concludes that his favorite TV shows are *Northern Exposure* (for its writing) and *Lois and Clark* (for Lois). His nontechnical reading is psychology and spirituality, and, he concludes, "I don't expect to ever retire, I'd like to teach others what I've learned and to continue to have interesting challenges and the resources with which to accomplish them." What a great note! Am sure there are more out there, so let this be an inspiration to us all!

Another communication for Grace Chin says that "on the day of my retirement (in 1987) I chose to ease the transition by traveling once a week downtown, studying jewelry design, just to keep in touch with the dynamic pulse of the city where I spent the past 30 years or so working as an architect." She says it wasn't until 1992 that she began concentrating on the pursuit of art, something she always wanted and found no time to do. "At the urging of friends, I began to look forward to the day when I would hold my one-man show, sterling silver jewelry design, enameling, and perhaps calligraphy." She has donated all her books to the Architectural Department, Chao-Tong University (the MIT of China) in Shanxi, China, to concentrate on her second career. Grace reports that they travel each year to Europe, the States, or Switzerland to see their daughter. She now divides her time among interior renovation of a senior center, caring for her son's pet (a lovable Maltese), and attending art classes. Grace is listed in the first publication of *Who's Who Among Asian Americans*, 1994-95. She says, "I am sure there are other deserving high achievers not listed. Is it because I studied architecture at MIT, or I'm

a woman, or a combination of all these factors?" What a wonderful update, for which I thank you, Grace.

Finally, and sadly, I received reports of the death of two classmates. David Morse, of Ithaca, N.Y., died in October 1994. He was a senior research associate at Cornell University's Wilson Lab, and the notice came from his spouse Helen. . . . David McGrath, founder of TAD Resources Intl., passed away in May 1995. TAD was a major corporation which grew over a 40-year period to over one billion in sales and 300 offices worldwide. David was active on numerous boards, including acting as director of the Carrol Center for the Blind, a member of the MGH Corp., an overseer for both the Tufts University School of Veterinary Medicine and the Boston Museum of Science. He was an avid golfer and leaves his wife, JoAnn (Resch), five children, and several grandchildren.

That's all for now. The updates here will, I hope, inspire more of you to *actually do it*—send an update which will be most appreciated by your classmates.—Dave Packer, secretary, 31 The Great Road, Bedford, MA 01730; (617) 275-4056; e-mail: <70421.1766@compuserve.com>

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There is little to report this month, but I won't be discouraged as reunion promises to send notes have been preempted by the activities of a busy summer for all. (I write these notes in August, while the Washington, D.C., area is still in the grip of 25 or so days of over-90° weather.)

From Grand Rapids, Mich., Charles McCallum—who was at our reunion—writes that he has been elected a member of the American Law Institute, a 3,000-member organization that plays a major role in the development of the law. Charles also suggests that we publish a class directory, a project your secretary would gladly undertake, if enough classmates would second Charles' motion. Let me hear from you. . . . Sue Schur was one of five women installed as a fellow of the Society of Women Engineers at SWE's National Convention in June. Congratulations! Sue, whose attendance at the reunion was limited by her Boston ad agency's demands, is still publishing and editing *Technology & Conservation* magazine and organizing conferences in connection with T&C. . . . Finally, another reunion participant, Bob Lienhard, writes that he, his wife, Mary, and son are living in London, England. Bob is a group director with Forte, a UK-based hotel and restaurant group.

Again, I ask for news from you and your comments on Charlie McCallum's suggestion.—Frank A. Tapparo, secretary and class agent, 15 S. Montague St., Arlington, VA 22204; e-mail: <ftapparo@lmi.org> or <ftapparo@aol.com>

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35th Reunion

Please send news for this column to: Andrew Braun, secretary, 464 Heath St., Chestnut Hill, MA 02167; fax: (617) 734-5230; e-mail: <andrewb820@aol.com>

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Richard L. Foster '51
CEO, Chairman of the Board

Jim Draper served as chair of the Technology Day Committee, helping to organize the 1995 Technology Day program held at MIT on Friday, June 16. Paul Gray presented

Jim with a signed Tech Day poster in a frame to remind him of the good job he did. In case you missed it, the report on the successful and highly-praised program appeared in the October issue, page MIT1. One highlight was a "fly-by" of six WWII aircraft including a B-25 "Mitchell" bomber of the type flown by the late General Jimmy Doolittle, '24. On its last pass over MIT, one of the aircraft trailing smoke executed the "Lost Pilot" maneuver to commemorate the sacrifice of many MIT graduates in past wars.

In other activities, Jim is involved with the James Cunningham Scholarship for Women in Engineering at MIT, along with Class President Mead Wyman. Jim's company, KTAADN, is building a patented lightning prediction system for NASA and various earth remote sensing projects. He is building a second log cabin (from cut trees) at his family's camp in Maine. He and wife Jane are very proud of their daughter Allison, who is an editor at Grove Press, and their son Stark, recently graduated from Stanford (Jim said "recently escaped"!) and is now in graduate school at MIT in Course VI (EE).

Albert L. Blackwell, professor of religion at Furman University, is co-editor of a new book of essays compiled in honor of Harvard religion professor Richard E. Niebuhr. In addition to serving as co-editor, Dr. Blackwell also wrote an essay for the book entitled *Richard R. Niebuhr: Reflections from a Grateful Student*. After receiving an SB in physics from MIT in 1962, Albert went to Harvard, where he received a PhD in Christian theology from the Harvard Divinity School. He has been on the Furman University faculty since 1971, and serves as the Reuben B. Pitts Professor of Religion. He received Furman's Meritorious Teaching Award in 1977.

Vic Caravito dropped me an e-mail message some time ago that he has returned from Europe and a three-year assignment for Goodyear at their Technical Center in Luxembourg. He is back working for Goodyear at their Ohio Technical Center as manager, knowledge systems. He is active as an MIT Educational Counselor in the Akron area. Since returning from Europe, Vic has been on two official visits with Randall Wright, SM '79, (officer in the Industrial Liaison Program) to check out the AI and media activities at MIT. Vic and his wife, Jo, are glad to be back in the United States, and he can be contacted via e-mail at: <ir001185@interramp.com> or through his employer at: <vcaravito@goodyear.com>.

Don Horner sent me an e-mail message to disagree with my comments on "chain gangs in Alabama." He is working in technology planning for the Ford Automotive Components Division as task force leader for making his division "Best in Class" in the development of intellectual property by the year 2000. I asked him about right-hand-drive vehicles, and he assured me that Ford is producing such vehicles for England as well as Japan. Don sounds positive about the reorganization activities at Ford and feels that the result will be a much improved management structure and

more efficient decision-making ability. . . .

Warren Zapol's son David graduated from MIT in June. Warren said the day was spectacular and the graduation address was the briefest he ever heard. David followed in his father's footsteps in Course VII, but Warren says that even if the course number is the same, the advent of modern molecular biology makes any other resemblance to the early 1960s coincidental. Warren is an anesthesiologist with the Massachusetts General Hospital in Boston.

Michael Riezenman sent me an update on his recent activities. He has been a senior editor at *IEEE Spectrum* since 1992, with responsibilities for test and measurement instrumentation and data communications. What he enjoys best is electric vehicles (EVs) and hybrid electric vehicles (HEVs), which have become his specialty. He has been interviewed by Sun Radio Network concerning why HEVs make more sense than EVs at this point in time. Michael's interest has led him to be appointed to the energy storage subsystems technical working group of the National Electronics Manufacturing Initiative. Michael gives occasional talks on EVs and HEVs, and once a year he teaches a one-day course on Sherlock Holmes at Hofstra University. He has kept in touch with Jesse Shereff who, like Michael, lives in New York City, where he currently manages a mutual fund for a group of private investors. Jesse is still a Gilbert & Sullivan fanatic, and he has assembled one of the world's most complete collections of G&S recordings and memorabilia.

I've also heard from Pete Maas who is on sabbatical leave at Los Alamos National Lab from his job as physics professor at Strathclyde University, Glasgow, Scotland. . . . Jerry Winston has been getting good feedback on his requests for contacts on evaluation of public-sector activities. . . . Dave Bragdon sends news about his son's graduation from Michigan and a visit with Bev and Jack Walker. I'll give more details on all this next month. . . . One final item, Arthur David Snider, professor of electrical engineering at the University of South Florida, Tampa, wanted to let us know that in 1958 he had to make a decision on whether to attend MIT or Caltech, and picked MIT at the last minute (thus becoming one of our classmates). In July 1995, he visited the Caltech campus for the first time in his life and found a memorable souvenir that epitomizes technology's contribution to society—a squirting calculator.

If you have any news of classmates or items that you would like to share with classmates please telecommunicate with: <mit1962@mitvma.mit.edu>. Alternatively, you can send a message directly to me at: <uabnhm01@ascncube.asc.edu>. If you still communicate by surface mail, please send your class news and personal notes to: Hank McCarl, secretary, P. O. Box 352, Birmingham, AL 35201-0352.

Both David Johnson, Course VI, and Warren Sewall, Course XVIII, contacted me to inform me that Alan Ramo, Course XII, died of a heart attack on May 19. They were both close to him and obviously shaken by his sudden and untimely death. You certainly will

remember him from Baker House and his exceptional success in sports, especially wrestling. If you were looking for a bridge game, Alan was your man and became a life master at 26. Alan earned an MS in geophysics from Caltech and did further graduate work at University of Texas/Dallas. He was a staff professional geophysicist with the Oryx (Sun Oil) Corp. and a world-renowned authority on geothermal physics. He had discovered the locations of significant sources of natural hot water. He met Doris in 1973 and consistent with his interest in water, they were nationally recognized for their leadership in the Coast Guard Auxiliary. They had just celebrated their 20th wedding anniversary. They have a son, Richard. If you are moved to do so, Doris suggests directing memorial contributions to the American Diabetes Association and the Finnish-American Society of Dallas-Fort Worth. Alan made a real impact on those who knew him. He will be sorely missed.

Keep the alumnews coming! Try to get it to Tech or me by the first of the month. You can reach me by snail mail: Shoel M. Cohen, secretary, Department of Psychology, Nassau Community College, Garden City, NY 11530; or e-mail: <71271.2627@compuserve.com>. You can also call me at home at (516) 489-6465. It would be great to talk to you personally.

I regret to announce the passing of our classmate William Schipsel in Syracuse last June 11. William was a native of Bridgeport, Conn. He

received his degree in physics and attended Syracuse University for post-graduate studies. At the time of his death, he was employed at Syracuse University. Surviving him is his brother David of Franklin Lakes, N.J.

Frank Marcoline of Utica, N.Y., has been renewed for the 1994-95 Class of 1964 Student Aid award. A newly graduated senior, Frank compiled an outstanding academic record in his physics major and was heavily involved in a UROP project with the MIT Center for Space Research. MIT has two instruments on board the NASA WIND satellite, as part of the interplanetary geophysics program. Frank worked on the instruments, which measure the velocity and density of high-speed protons and alpha particles from the sun. He was also a member of the MIT varsity sailing team.

The Association of Alumni and Alumnae thank you for the contributions made towards this fund. Your continued generosity allows the Institute to sustain its commitment to fine students such as Frank.

John Meriwether (<meriweje@clust1.clemson.edu>) is now a professor of physics at Clemson. His area of research is that of upper-atmosphere physics, so his chemistry background at MIT has always been handy. John majored in chemical physics at the University of Maryland and graduated with a doctorate in physics from Maryland in 1970. Because the chemical physics program had no PhD degree per se, he had the choice of taking his degree in physics or chemistry. He elected to go with physics, and perhaps that explains how he managed to get a job in the physics department at Clemson.

From Silicon Valley to the Classroom: You Have to Like the Kids

Eugene Mallove, '69, gleaned the following story from the June 15, 1994 Atlanta (Ga.) Journal/Constitution.

Student teacher M. Danielle Beaudry was following her lesson plan. Under "instructional strategies," it specified "wander around." She moved around the Independence High [San Jose, Calif.] classroom, helping algebra students with the assignment: prove the Pythagorean theorem.

After a month of student teaching, Beaudry knew the bright kid who was only getting a C, the gifted student who liked "challenge questions," the girl who never spoke.

At 46, Beaudry is starting a second career as a high school math teacher. In her first career, she was research and development director at Software Publishing Corp. She earned a PhD in electrical engineering and computer science, master's degrees in statistics, electrical engineering, and management at Stanford, and an SB in physics from MIT in 1969.

Why would she give up a highly paid career to be a teacher? "I like the kids," she said.

"First you learn, then you earn" was her motto. But last year, after finishing

a Sloan fellowship at Stanford, she took time off to look at her options. She decided she wanted to teach, but not as a college professor. She wanted to interact with students instead of lecturing at them. Her husband agreed that they could live without her six-figure salary. They gave up the season tickets to the opera. Volunteering as a teacher's aide at Palo Alto High per-

As a novice math teacher, Beaudry expects to earn about one-fifth what she could make in Silicon Valley.

sued her that this was the right decision. In January, she started San Jose State's teacher-education program. She learned to vary teaching techniques to accommodate students' different learning styles: The Pythagore-

an lesson was geared to students who learn best "hands on."

New teachers are taught to teach "across the curriculum." Her lesson on the Pythagorean theorem started with a timeline, showing when the concept was developed in different places, and with a map, so students could identify Egypt, Babylonia, Greece, and Italy.

Silicon Valley experience can be valuable, said Beaudry, but there's a lot more to teaching math than knowing math. First, you have to like teenagers. "You can't just tolerate kids. You have to like them or you don't belong in a classroom."

Then, you've got to be able to work by yourself. "There's collegial interaction compared to industry."

Beaudry plans to use her Silicon Valley contacts to get donations and to set up field trips, such as a visit to Sega's game-testing operation. "I can beg."

In the long term, she hopes to influence education policy and the use of technology in schools, but first she'll concentrate on classroom teaching.

As a novice math teacher, Beaudry expects to earn about one-fifth what she could make in Silicon Valley. "First you learn, then you earn, then you teach. This is payback time."

John reports his career has been one of several major career changes. First a research scientist at Arecibo Observatory in Puerto Rico, then a research scientist at the University of Michigan, then a government civil servant at the Phillips Laboratory, and now academia. He says the bottom line is not to be afraid to learn new things and to take on new challenges.

Mike Drooker reports that the great MIT Class of 1964 was well represented at the 30th Reunion of the great Wellesley class of 1965. While attending with his wife Penny, he met classmates Dave Saul and Roger Hybels, who attended with their spouses. Classmate Mike Monsler was not present, but he was represented by his wife, Barbara, and daughter, Karin (Wellesley '93). All of this attests to a long-standing relationship between two great schools. (Nowadays, there is a shuttle

bus between MIT and Wellesley.)

Mike would also like to report the status of his Alumni/ae Fund Rowing Challenge. For the last year (between Technology Days), he logged 1,143 miles of rowing, most of it on the Charles River. He started this year's season on April 24 having waited until the water warmed up a little bit above solid-liquid equilibrium temperature. As yet, he hasn't heard of any classmates who will pledge an amount of money to the MIT Alumni/ae fund for each mile he rows. If anyone would like to make a pledge to spur him on, please speak up. His objective is to get so many pledges that MIT will hire him to be a "row-ing" ambassador and send him to southern locations during the winter. So drop a dime, or a quarter or more. If you can't do that, drop me a line.—Bill Ribich, secretary, 18 Revere St., Lexington, MA

02173; tel: (617) 862-3617; fax: (617) 890-4084; listserv: <mit1964@mitvma.mit.edu>

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Next month we will have a long column to get caught up on many different classmates. This month features a column by John Golden, who volunteered in my absence to cover

the 30th Class Reunion. John writes: "The 30th Reunion was a smashing success. Our class mustered 61 classmates and 49 significant others for a total of 110 souls plus Amy Schrom, our dedicated MIT staff representative. The kick-off at the Cambridge Sail Loft restaurant on Memorial Drive was well attended. There we conducted the initial planning for our assault on the Alumni/ae Challenge Games prize. Saturday brought forth a

great Texas barbecue lunch outside the Johnson Athletic Center and then the teams formed up for the challenge games. Our class president, **Peter Heinemann**, did an outstanding job recruiting (begging, dragging, etc.) alumni/ae and friends for our team. As the 30th Reunion class, we were the oldest alumni/ae allowed in the games (competing with the 5th, 10th, 15th, 20th, and 25th!). There were six events, beginning with the paper airplane distance and accuracy throw in which **David Cohn** and his son won the distance competition for us! With such a great start we became the only 30th Reunion class to ever win the Alumni/ae Challenge events! **Dave Manalan** reminded us all that we should not be surprised since we were one of the few classes to win the infamous 'glove fight' in both our freshmen and sophomore years! At the ShaNaNa event Saturday night, we hoisted our orange banner (each challenge game class had a different color) to the rafters and celebrated our total victory. We wound up the weekend over Sunday brunch at the Blue Moon cafe in Cambridge. Class officers were elected and goodbyes were said until our 35th Reunion (in 2000!). The incoming officers are **Peter Heinemann**, president; **Steve Duetsch** and **Bruce Sunstein**, VPs; **Dave Manalan**, treasurer; and **John Golden**, class agent. We were pleased to report \$230,200 in class gifts with 50 percent of the class participating—putting the Class of 1965 in a tie with the Class of 1962 for record participation in a 30th Reunion gift. Everyone at the reunion hopes that we get even more people back to our turn of the century party in the year 2000 for our 35th Reunion."

As for the McKinnys, we were blown away by China. Recommendations are: Beijing (of course), Xian (2,000 year old terracotta warriors) had far more than we expected, and Guilin (mist-enshrouded hills of Chinese paintings) was an extraordinary geologic sight. Our favorite experience, however, was the wheat harvest in the Yellow River delta near Confucius' home (Qufu).—**George McKinney**, secretary, 33 Old Orchard Rd., Chestnut Hill, MA 02167; tel: (617) 232-4710; e-mail: <georgemck@aol.com>

66 30th Reunion

Well, I didn't get much in the way of summer vacation news. Thought things would pick up a little with the 30th Reunion coming up so soon. I guess you're all saving your news for the reunion itself.

Michael Adler, a member of our 30th Reunion class gift committee, notes that his son, Joseph, '96/'97, has had three UROP's while at MIT so his own contribution has gone to the Class of '66 UROP Fund.

I am forced to update you on Klepser activities. **William Klepser** finally found the time to take (and pass) the PE exam. He really did it now because he didn't want our daughter, Cheryl, '91, to be a PE before he was and she'd already passed the first part. Cheryl has left MIT after eight years with an ScD in materials science to work for Cummins Engine. I shall miss having a place to stay when I visit Cambridge. Our daughter, Erica,

works for the IRS in the three Northeast districts as a taxpayer service representative. Cheryl and I still backpack, this year on a section of the Appalachian Trail in Connecticut, but we've also added bicycling to our repertoire. The bike trails around Boston are terrific but the traffic circles are something else again.

Unless you want me to bore you with more Klepser news, get those cards and letters in here!—**Eleanore Klepser**, secretary, 84 Northledge Dr., Snyder NY 14226-4056; e-mail: <vismit66@ubvms.cc.buffalo.edu>

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Please send news for this column to: **Charlotte and Jim Swanson**, co-secretaries, 878 Hoffman Terr., Los Altos, CA 94024; e-mail: <jswanson@lat.com>

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As we write this summer is coming to an end so we hope you all had a good summer and are looking forward to a happy holiday season. You may recall that we have been

soliciting input by e-mail, so we have to declare this month's Class Hero: **Len Goodman** who can be reached at <lenny@xyvision.com>. Len writes, "Been meaning to write to you for a long time, but procrastination was in control until now. I was working for Intermetrics, Inc., on Space Shuttle flight-computer software from the late seventies until 1993, both in the main Intermetrics office in Cambridge and then in Huntington Beach, Calif., until I became part of a company-wide downsizing and was unceremoniously detached. Since I had been feeling quite homesick for the Boston area during my California stay, and had never made the transition to being a true Californian, I returned to Boston in the spring of '94. The move regenerated me, and I felt at home quickly. After an eight-month assignment as a software consultant (my first stint in this branch of the job market), I got a full-time position at Xyvision in Wakefield, Mass., doing software Q/A and also development. I keep in touch with **Jerry Sabath**, who works at Agfa/Beyer in the Boston area; we recently went to Fenway Park to cheer on our Red Sox."

Our official supplier of class T-shirts, **Roger Fox** writes that he spends much of his spare time dealing with multiple solicitations from the Alumni/ae fund "because they don't trust me to remember to send a check before June 30."... Finally, **John Dehne** reports that he is president of Loral Infrared and Imaging Systems in Lexington.

That's all we have for now. Keep those cards, letters, and e-mail coming.—**Gail and Mike Marcus**, secretaries, 8026 Cypress Grove Ln., Cabin John, MD 20818; e-mail: <ghm@nrc.gov> or <mmarcus@fcc.gov>

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Let's wrestle again with the continued saga of **Roger Chang's** wrestling avocation. **Roger** writes, "After all these years I have still been active in wrestling! My son Mike just

ClassNotes

won his second county title and will compete in the states for the third time. He got injured twice before the nationals. We even publish the official Maryland state wrestling newsletter. Coach Chassey would probably be surprised."

See feature on **M. Danielle Beaudry** opposite. I suppose it may lure a few of you away from your six-figure salaries in "high tech." Hey—1969 *Technique* says that Danielle originally hails from Manchester, N.H.! Just down the road a bit, Ay-uh.

Sorry, no other notes this month. Time to run off and put Issue #3 of *Infinite Energy* to bed. Good news is that this one will get into Barnes & Noble superstores.

Those of you who are fully electronic can reach me or submit class notes via e-mail: <76570.2270@compuserve.com>—**Eugene F. Mallove**, secretary, 171 Woodhill-Hooksett Rd., Bow, NH 03304

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We are still experiencing the glow from our 25th Reunion. **Bill Copely** writes that he was able to persuade four of his five children to tour the campus one day of the

reunion, and they all had a great time hanging around with **Peter McCall**. Bill says that his 12-year-old daughter liked the new Burton House so much she wants to attend the Institute.

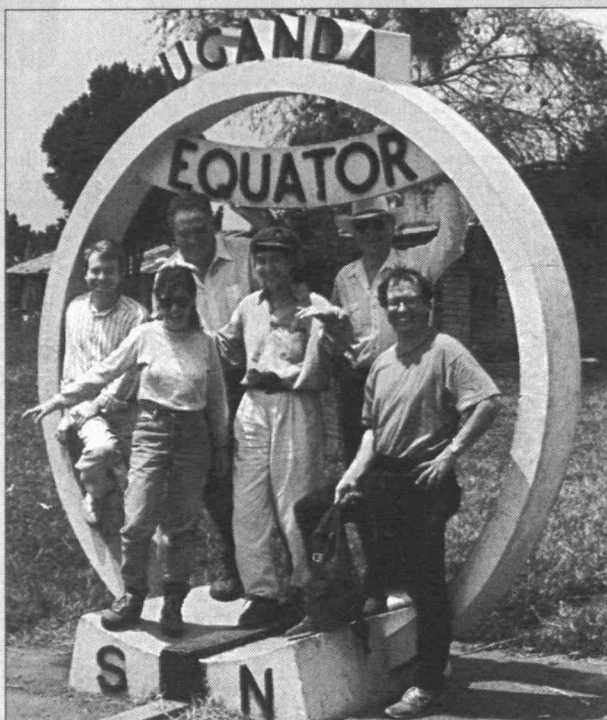
Speaking of Burton House, there was a mini-reunion at the end of June at a beach house on Lake Michigan for former residents of Burton I. We received the following report via e-mail about the attendees:

Stephen D. Smith and wife **Judith L. Baxter**. Steve has been professor of mathematics at Uillinois/Chicago since 1975, working in finite group theory with a semi-infinite number of PhD students. Empty-nesters now, Steve and Judy are spending more time on adventure travel. . . . **Daniel R. Cherry** is a single parent supporting his 17-year-old son and 4-year-old daughter as a patent attorney in Chicago. Twenty-five years after MIT, he finds that he was older then, younger now. . . . **David L. Engler**, wife **Annette M. Mott** (Wellesley '71) and son **John** (age 13) write that David is currently manager of Mechanical Engineering for Neill & Gunter, Inc., in Scar-



CORRECTION: We misidentified one of the Class of '70 marshalls in the Commencement procession in the Aug/Sept issue. Hoisting the banner with Alumni/ae Association President **Karen Arenson** is **Robert Dennis**. We apologize for the error.

PAUL RAEURN, '72 (far right), and his fellow journalists marked their arrival at the equator with a photo op. The group was on a four-week tour last February that took them through six African countries, and Raeurn, who is the science editor of Associated Press in New York City, wrote a report on the adventure for the Newsletter of the National Association of Science Writers. The trip, sponsored by the Council for the Advancement of Science Writing with support from the W. K. Kellogg Foundation, was designed to give the writers a look at the con-



tinents' agriculture. They met with farmers battling exotic pests, deteriorating soil, and skyrocketing prices for fertilizer and with researchers determined to help Africans feed themselves. The journalists hiked through nesting areas of potentially dangerous mountain gorillas and traveled through parts of Mozambique where land mines left over from a 10-year civil war were a real threat. But Raeurn says that the closest they came to any real danger was the occasion when they found swarms of carnivorous driver ants crawling all over their shoes and up their legs. □

borough, Maine. When not restoring a 100-year-old farmhouse in Bowdoinham, Maine, or engaged in raising their three sons (Daniel, 18, and Peter, 16, stayed at home), he and Annette are sailing their sloop *Ruah* along the coast of Maine."

We have some other reports, too. Vinay Rai tells us about his "extracurricular" activities. He is an executive committee member of the Federation of the Indian Chamber of Commerce and Industry, and chair of the Management and Human Resource Development Committee. He is also Chair of the Indo Joint Business Councils with Australia, New Zealand, Greece, and Cyprus, and chair of the Institute for Integrated Learning in Management. He is a past president of the Indian Electrical and Electronics Manufacturers Association. We nonetheless feel confident that Vinay still has time to run his business, Usha Rectifier Corp. Ltd.

Joe Baron says that he is traveling a lot to China as he is shifting his manufacturing for Gardener's Helpro from Taiwan to China, because of the labor costs. He reports that there is a huge potential in China for labor-intensive manufacturing, such as the machining of stainless steel and aluminum.

John Stempeck tells us that he recently joined Xerox Corp. as director of strategy and business development. . . . David Lynn was recently named director of residency training in Psychiatry and in the Combined Internal Medicine/Psychiatry Program at Saint Francis Medical Center in Pittsburgh. . . . Bill Chotkowski has begun a new software company, ABCO. His oldest son, Alexander, will graduate from Franklin Pierce Law School next June, and his younger son, Matthew, is attending UVM on a basketball scholarship.

Lim-Ming Chui reports that his children are following in his footsteps. He is the current Bay State Master's Table Tennis Single's

champion. His son Chi-Sun Chui, '93, was a member of the 1995 United States Pan American Games table tennis team and won a silver medal. His daughter, Jane Chui, a sophomore at UMass/Amherst, won the National Intercollegiate Table Tennis Women's Single's championship last year and this. . . . A year ago Lou Zarfes married Gay Colyer, his second wife. His daughter, Kat, is a sophomore at Thomas Jefferson High School for Science and Technology and rows crew. His son, Davis, is in the eighth grade at Frost Intermediate. Last winter, Lou became chair of EXCEL, a networking group for persons with disabilities. In January he was appointed supervisory design patent examiner, and he continues to edit the *Journal of the Patent and Trademark Office Society*.

Dan Galehouse writes from the "sticks of Ohio" that he is finishing a couple of journal articles while his wife, Donna, is running the DNA lab at Children's Hospital in Akron. Their boys are "moving through high school and college (with the usual complaints)." —Greg and Karen Arenson, secretaries, 125 W. 76th St., Apt. 2A, New York, NY 10023; e-mail: <dhbm13d@prodigy.com>

71 25th Reunion

Our 25th Reunion is coming, soon. If you want to help with reunion plans and activities, contact the Alumni/ae Office. Save your money for a class gift and plan to attend.

Joe Martin is now working on new statistical services for public-policy advocacy and management education in community health and health system integration as VP, Health and Statistics, American Hospital Association in Chicago.—R. Hal Moorman, secretary, P.O. Box 1808, Brenham, TX 77834-1808

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Please send news for this column to co-secretaries: Wendy Elaine Erb, 6001 Pelican Bay Blvd., #1001, Naples, FL 33963; Dick Fletcher, 135 West St., Braintree, MA 02184

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Jeff Cove has been named a VP of Matsushita Electric Corp. of America, now as president and general manager of the television division. He has been with the company since 1983, as GM of that division and in several other managerial roles. . . . John Breen is still scoutmaster of Troop 92, Southboro, Mass. They camp once a month, year-round, and John notes that the program has grown from 9 boys in 1992 to 36 active scouts today. He insists that his wife, Wendy, sons Chris and Todd, and daughter Lisa are very supportive.

Martin Rosenberg was written up in the *Omaha World-Herald* for the publication of his first book, *Raphael and France: The Artist as Paradigm and Symbol*. He is a professor of art history and department chair at the University of Nebraska/Omaha and has been working on the book since his doctoral days at Penn 15 years ago. It covers the impact of Raphael, an Italian Renaissance giant, on French art from the late 17th to early 19th centuries. . . . Carl Wieman is one of 60 newly elected members of the National Academy of Sciences. The honor is in recognition of distinguished achievement in original research.

Yours truly and Martin Romeo were two of 130 members of the Alexandria Harmonizers who were awarded gold medals upon winning the international chorus championship of SPEBSQSA, the barbershop society, in Miami Beach last July. It is the third gold medal both for Marty and for me, having won in 1986 and 1989.

Write or e-mail!—Robert M.O. Sutton, Sr., secretary, "Chapel Hill," 7721 Churchill Ct., Marshall, VA 22115; e-mail: <sutton@smp.pcmail.prc.com>

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The story about the MacGregor D entry party at the 20th Reunion inspired Piero Di Capua to write from Bogota, Colombia. Piero has been in touch with several other D

entry chaps. He has spoken to Jacques Nasser in Brazil, and John Cone in parts unknown (John, write and tell us where you are). Piero also reports that Ibrahim Hasan is doing very well in the agricultural business in Jakarta, Indonesia. Piero promises that he, Jacques, John, and Ibrahim will join us at our 25th Reunion. After graduating from MIT, Piero obtained an MBA from the Wharton School. Then he started working for Petroquímica Colombiana S.A., a producer of PVC resins and compounds, founded and run by several MIT grads. Piero is the financial director (CFO) of Petroquímica and has a management role in some of its sister companies. Piero has two children, Gabriel (2 1/2) and Lydia (6 months).

Alan Ritter's company just got their Internet connection, and he found e-mail too easy to pass up. Somehow it is easier to find a few minutes at his workstation than to sit down at the computer at home, type, and print a letter and envelope, and actually find one of those funny square things with glue on the back. Alan has been married to Marcia for 13 years, and their first, last, and only son, Nathan, is a 6-year-old kindergartner going on PhD. Nathan started backpacking last year. He climbed Mt. Ritter, a nice little 4006-meter (13,150 feet) peak about 30 miles south of Yosemite. We're wondering if this mountain is part of the family estate. Son Nathan managed to haul himself and about 10 pounds of backpack 7 miles in one day.

Alan is a research fellow at Storz Ophthalmics, Inc., in St. Louis, where he has worked for 13 years. The company produces surgical instruments, diagnostic and surgical electronic systems, implants, etc., all for ophthalmologists. He has spent most of his tenure working on ultrasound diagnostic equipment, with occasional forays into the microsurgical electronics arena. A number of years ago, he branched off into the management track, found that those headaches were even worse than the technical ones, and migrated back to the technical arena. Fortunately, the company set up a "dual ladder" system, so his tenure and expertise count for something even if he prefers to stay technically oriented. When not climbing up mountains, Alan wanders around the bottom of the ocean. He tries to head down to the warm, clear waters of the Caribbean at least once a year.

I received a short note from Hannah Rose Lamson Freedman (class of 2015). Her father, Richard Lamson, graduated from the University of Maryland School of Medicine. He will be starting his family practice residency at the University of Maryland, while his wife, Joan Freedman, continues to design educational software at the Johns Hopkins School of Medicine on the other side of Baltimore.

Our class co-secretary David Withee was recently promoted to director of marketing.—Barry N. Nelson, co-secretary, 65 Hillside

Ave., W. Newton, MA 02165-2543; tel: (508) 663-7598 X1524; e-mail: <bnelson@cspi.com>; David Withee, co-secretary, 3702 Adams St., Two Rivers, WI 54241-1404

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Peter Dinhofer graciously put together the following. "I want to announce the opening of the Class of '75 list server, which we will be using for general announcements and to help all

of us keep in touch. In addition, we will endeavor to get out an early pre-release copy of the *Review* class news to everyone on the list server. All those interested in getting on the list server should e-mail me a note at <us002795@interramp.com>. Our first announcement successfully flushed out many of our classmates who tend to avoid 'snail' mail.

"Alex Henry announces a new addition to his family, a daughter: Katherine Hunter Henry born June 14, 1995. . . . Larry Kahn is still playing tournament tiddlywinks after 24 years. He says, 'In May I went to England where I regained both the world singles and pairs titles, at the same time becoming the first person to hold all the major world and national titles simultaneously.' . . .

Mark Czerwinski writes: 'I work at Lincoln Lab as the group leader in the Processor and Communications Technology Group. I live in Lexington with my wife, Barbara, my son, Steven (11), and two dogs. In our free time we try to get away to Maine to sail our boat in the Casco Bay.' . . . I got the longest e-mail message from Miles Fidelman, who writes: 'I'm spending most of my time as cofounder and president of The Center for Civic Networking, a three-year-old nonprofit that focuses on civic applications of the Internet. Some of the things we do include: getting Internet terminals into the Cambridge Public Library; speaking, writing, policy research, and advocacy, regarding telecommunications issues; as well as working with local governments working on citizen participation projects with an electronic component; and developing online services for the Federal Trade Commission. I also spend a little bit of time helping my wife out with two multimedia publishing ventures. In *The French Body* and *In The German Body* are interactive videodisc programs for use in the classroom. Think of them as method acting in a foreign language (Keven Kline apparently used *In The French Body* to help him learn French mannerisms for his role in *French Kiss*). The other, *The Agora Language Marketplace*, is an Internet Buyers Guide.'

"I want to remind everyone that we are 'online' and if you want to send us something to include in the next issue, just e-mail it to me, Peter Dinhofer, <us002795@interramp.com>."

Thomas Jacobs writes to say that he is approaching (and, by now, has passed) 13 years with NYNEX in Boston. He and Sharon Gardner, '79, had just celebrated the first birthday of their third child, Nathaniel, and will soon celebrate their 16th anniversary. . . . Jay Nadelson mysteriously sent only an e-mail address: <vintagemg@aol.com>. . . . Diane McKnight writes, "I continue to conduct water-quality research working for the U.S. Geological Survey, studying interesting field sites (acid mine drainage streams in the Rock-

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ies, contaminated areas at Rocky Flats, and the Dry Valleys in Antarctica). The USGS has survived the budget axe for this year, but is going through major changes. Larry Esposito, '73, and I are now parents of a teenager (Rhe, 13) and a 9-year-old (Ariel)." . . . Noreen Hickok dropped a line to say she has two wonderful children, Christopher (3) and Catherine (6 mos.), at the time of writing. Like most academic researchers, she is spending all her time writing research grants trying to maintain the level of funding she's grown accustomed to!

Brenda Blake Schilinski retired from the U.S. Air Force after nearly 20 years. She achieved the rank of lieutenant colonel and retired on June 30, 1995. Her new career was still up in the air at the time of writing, but possibilities included: starting a business, classified space systems, or miniature vegetable gardening. . . . Ramon J. Vallejo is presently a technical manager for Shell Off-shore, Inc., responsible for exploratory development and production activities in a section of the Gulf of Mexico. . . . Edward W. Caparelli has this to say: "I continue to work in East Tennessee trying to bring affordable health care to poor mountain people and Mexican migrant farm workers. The restructuring of Medicaid here in Tennessee (called Tenn Care) has made that increasingly difficult causing me to become active politically. I currently am president of our county medical society and delegate to our state medical association."

And this from Gary N. Foster: "I'm still on the school board here in Kenosha—up for reelection in April 1996. Can't say I've changed the direction of public education here. How do you push 200 tons of jelly?" . . . After years of working in Arlington, Va., on the FEWS Project (Famine Early Warning) in the sub-Sahara, Marian L. Mitchell has taken a great leap and moved to Swaziland. She is working for the UN's FAO, organizing the computerization of the Swazi food-security program in the Department of Home Economics. . . . As of June 14, 1995, Frank Newman was planning to leave his Treasury Department post of nine months to return to the private sector.

Finally, right before our reunion, the Alumni/ae Association received a letter from Charles Baker, expressing his regrets that he could not be with us but that he had been doing a not insignificant amount of traveling in 1995 and was presently in New Mexico. He had recently driven from New Hampshire to Florida and then on to New Mexico. He had been in Las Cruces, Ruidoso, Albuquerque, Taos, Moriarty, and was writing from a small stopping point on I-40 at about 4,600 feet. Charles indicated that, now in New Mexico (as opposed to Maine where he had been living) he hoped to return to his "former obsession," bicycling.

Hope all is well with the Class of '75. Having been ridiculed roundly at our reunion for my "quill pen" approach to preparing class notes columns, I want to let you know that I can be reached at the following e-mail address: <dk@execpc.com>. Thanks to Peter for helping with this column and providing other electronic means for communication.

That's all for now.—Jennifer Gordon, secretary, 18 Montgomery Pl., Brooklyn, NY 11215

76 20th Reunion

If it were not for e-mail, we would not have any news in this issue. Write. Fax. E-mail.

Call. Send news!

From e-mail, we have finally heard from Steve Isaacs after a 20-year hiatus. Following are excerpts from his travelogue. "It was quite haunting to spend five days last March visiting Bob Steininger in Boston; all the memories from that other life so long ago came popping into my head at random moments. And it really was another life, followed by a chapter in Northern California followed by a chapter traveling with backpack in Europe, a chapter in the Denver area of Colorado, a chapter in Hannover, Germany, and now here (Denmark)."

"I can give a few comments about my experiences. I had to write my entire thesis (200 pages) in German, and my defence consisted of a 45-minute lecture in German followed by a closed examination with five professors in German. Naturally, after being there four years, I was quite fluent in the language and could have passed any American language exam with flying colors without a dictionary. But it is quite something else to write in German. I always had been amazed at people who could fluently speak several languages, and now I can understand how it is, since I speak, think, and dream interchangeably between German, Danish, and English.

"Here in Denmark, the land with a short summer and long winter, I cannot say if what I am doing with my life and career is very wise. I am not getting rich, I am paying 62 percent of my salary to taxes (health insurance is included, at least), and I have probably little chance to get much higher up than a project-paid researcher here at this university. But I like living abroad, and in Europe, even though the Europe of today is not as nice as the Europe of the 70s and 80s. One thing I enjoy extremely is the long vacation time (five to seven weeks per year). Last spring I spent two weeks in the States and then a short five weeks later I was in Greece for three weeks.

"I don't have a car. I can't justify having one while living in the city and being on my own (yes, I am on my own, never been married, no kids, etc.). So I bicycle the 14 kilometers each way to work and back, summer and winter."

Our e-mail effort, the Class of 1976 listserv, continues to grow. We now have more than 180 classmates' e-mail addresses. We are using this facility to distribute the Class Notes, the e-mail address list, and for discussion of reunion ideas (e.g., we might consider a commemorative CD-ROM). I have observed a lot of formerly sundered friends renewing friendships thanks to having e-mail addresses. So unless you have a very pressing reason not to, I urge you to send us your e-mail address for inclusion.

As for your secretary, he remains busy trying to scratch a living out of the computer business. There are days where I think I am the only person in the world buying anything. I have one observation to share with you about technology—it is worthless without a customer! Customers are always in short supply.

As for the markets, they remain very volatile, giving me a bumpy ride. Ouch! You might think that after 20 years of trading futures, etc.,

I would be inured to the ups and downs. Unfortunately, that is not the case. I have a very thick hide; but even I can be stung. Fortunately, there have been no fatal injuries, just some painful ones.—Arthur J. Carp, secretary, Quantalytics, Inc., 220 Henley Rd., Woodmere, NY 11598-2523; tel: (516) 295-3632; fax: (516) 295-3230; e-mail: <quantalyt@aol.com>

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Please send news for this column to: **Ninamarie Maragioglio**, secretary
9727 Stipp St.
Burke, VA 22015

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Rockin' babe **Julie Stahlhut** sends us news from the Wolverine State: "After a year as an entomology student at Michigan State University, I have transferred to Western

Michigan University in order to pursue a PhD in biological sciences closer to home. By the way, editors, note that the only 'y' in 'entomology' is at the end!" (Your class secretary must take credit for presenting an edited spelling to the editors!)

Dave Leblang <leblang@atria.com> writes, "I have finally conformed to every MIT stereotype: I married a Wellesley woman, have two kids, live in the Boston suburbs, and I started a software company that went public last year. My daughters are wonderful and my wife is, by necessity, understanding! The company, Atria Software (ATSW) is a software

tools company started in 1990 with fellow alumni Paul Levine, '76, Bryan Douros, '76, and Bob Chase, '82."

We received a press release about **Mitchell Weitz** who has joined the law firm of Porzio, Bronberg & Newman, P.C., as counsel to the firm that has offices in Morristown, N.J., and New York City. The release says that Mitch received an MA in chemistry from Harvard and law degree from Harvard Law School in 1984. Mitch resides in the Big Apple.

Brad Schaefer sends a postcard from New Haven, Conn.: "I've just moved to New Haven as a professor of physics at Yale. I'm having great fun with research on gamma ray bursts and supernovae. As for various hobbies, my chess rating has gotten as high as 2130, I can juggle four balls in three patterns, and I've been a consistent third place in North American winks. My wife (Martha Williams Schaefer, '79) has just published (with Guy Consolmagno, '74) an introductory textbook on planetary astronomy. We have a huge new house, along with a nice beagle (Sox) and husky (Grendel) to live in it."

Howard Katz sends a magazine and newspaper articles about the interesting work that his team at Bell Labs has been doing: fabrication of organic transistors. The team dramatically improved a number of parameters so that the technology is applicable in practical large-area electronic circuits such as liquid crystal displays. Howard is the organic chemist on the team. As he says, "What better project to work on at Bell Labs than transistor fabrication? Otherwise my wife, Marion, continues to build

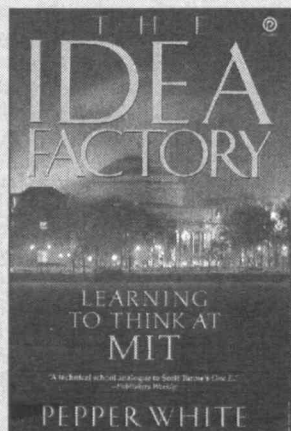
ClassNotes

her CPA practice, located at our home in Summit, N.J. Our older son, Joshua, is starting middle school and plays the trombone (bass clef runs in the family). Our younger son, Jeremy, is a star goalie in the Summit Soccer Club. I still play cello in the South Orange Symphony and tennis in the park. We celebrate 15 wonderful years of marriage this December."

Alan Marcum <amm@next.com> sends us good news as well: news of a baby girl. Rachelle was born in April 1995. "Rachelle's big brother, Joshua, likes few things more than holding his new baby sister. My wife, Barbara, and I are still living in Palo Alto—same house for me since 1980—though we added a room last year. I'm still at NeXT Computer, nearly seven years (all of it in tech support, now with fellow 'Tute alums Joe Keenan, '80, and Manavendra Thakur, '88). On other fronts, I'm on the boards of my flying club (West Valley Flying Club) and congregation (Keddem Congregation, which I helped found in 1992). These along with my job, family, and nontechnical business interests with IDA International (a marketing and distribution company) generally keep me out of trouble."

As for your class secretary and wife, **Diane Curtis**, we've recovered from our first full spring season in real estate as Curtis Real Estate. About half of the year's real estate sales in the area occur in the spring. This

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makes for a tumultuous but rewarding time. (This is partly why you've been without Class Notes for the past couple issues.) Danielle (4 1/2), Luke (4), and Hannah (2) are all doing great, and probably have more understanding about home-buying than most kids their age!

With the Ohio August weather in the steamy 90s, I find it amusing to wish you all the best for the holidays, which is when you'll be receiving this issue of Class Notes. Please send or fax us news about the past year. It's always great to hear from MIT classmates.—**Jim Bidigare**, secretary, 9095 North St. Rd., NW, Newark, OH 43055-9538; tel: (614) 745-2676; fax: (614) 745-5648

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Christopher Rose writes that he is "still plugging along after a few years in the academic life. Now beginning to scout out business ops in wireless communications, for two primary reasons: 1) I'm associated with WIN-LAB, the wireless lab at Rutgers, and if I can't make a go in this area, I'm brain-dead, and 2) when college time rolls around for my boys (Steve, 10, and Evan, 7), and they say MIT or Harvard, Steph and I will go bread-dead trying to figure out how to pay for it!" Christopher got a PhD from the "Tute in Course VI in 1985. He can be reached via the Internet at <crose@ece.rutgers.edu>.

The Alumni/ae Association has sent me a letter regarding the three students whom the Class of 1979 Scholarship Fund is currently subsidizing. Mark Story, a senior in electrical engineering and computer science from Six Mile, S.C., plans to attend graduate school in engineering but is also considering an academic career. He has been active in the UROP program as well as sports. Kenneth Volmer, another senior in EECS, is from Syracuse, N.Y., and plans to attend graduate school and eventually become the founder of a technology innovation company. He has been active in dorm government and intramural basketball. Elaine Yiu, another Course VI, hails from West Keatsburg, N.J., and plans to go for a master's degree. She has been involved in UROP working on semiconductor devices, and also pursues ballet and piano playing. Thanks to all classmates whose contributions makes these scholarships possible.

Your faithful secretary was recently married and has just returned from a two-week honeymoon in Alaska. The scenery was unique and spectacular. Wishing all of you happy events.—**Sharon Lowenheim**, secretary, 98-30 67 Ave., Apt. 6E, Forest Hills, NY 11374

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Now I know what happens when you don't attend the class reunion—you get reelected class secretary! Since I will be doing this for another five years I hope you will all help

me by sending your news on a regular basis—you can call, write, e-mail, or send notes with your annual contribution to the Alumni/ae Fund. The other class officers are **Tabetha McCartney**, president; **Alan Weger**, reelected VP/treasurer; and **Tim McManus**, **Marty Plys**, **Gwen Shafer**, members at large. Thanks to **Kate Mulroney** for serving as president the past five years.

Just a few birth announcements this month: **Enora (Kunica) Rogers** and her husband, Kevin, are pleased to announce the arrival of their son, Kyle Andrew, on April 3, 1995. Enora is currently working at Cordis Endovascular Systems in Miami as principal engineer heading up advanced R&D. The company develops products for interventional neuroradiology. . . . **Michael Monaco** writes that his son, Daniel Robert (born July 29, 1994), is a great joy. . . . **Deborah Darago**, '77, and **Calvin Winey** welcomed their third baby girl, **Natasia Elizabeth Winey**, on June 4. At 2 a.m. they were debating whether Deborah's labor was real (they had had two false alarms). They decided to get to the hospital in plenty of time—Natasia was born at 3:26 a.m.! Her two sisters, **Larissa** (13) and **Tatiana** (10), fight over who gets to take care of her. Calvin is still working at Howtek (10 years) developing color-image scanners and image-processing algorithms.

Send your news to: **Kim Zaugg**, secretary, 549 Fairfield Rd., Canton, MI 48188; tel: (313) 981-1785; e-mail: <vayda@erim.org>.

81

15th Reunion

Another year draws to a close. Can you believe it?

Special Educator: Laura

Guthals has put first things first. She has gone on extended leave from teaching high school math to stay home with her children—**Stephanie**, 7, **Nathaniel**, 4, and **Philip**, born in October '94. Laura participates in parent cooperative preschool, and is active in church activities. She is also gaining expertise in the field of special education, since two of the children have Down's syndrome.

The Fifth Degree: Life is good for **Guy Vachon**. He's still in Austin, Tex., as head of telemetry and acquisition hardware front end for Schlumberger. On top of that, Guy's now working on yet another degree to add to his collection from the Institute—this time it's an MBA from the University of Texas, which he expects to receive in about a year. Guy tells us, "It is fun to be back in school, though I had become fond of sleeping regular hours."

Jeremy Spoke: Always glad to hear from **Jeremy Barkan**, who writes regularly from Jerusalem. Jeremy's working at Accent Software, a Jerusalem software company started by **Bob Rosenschein**, '74, that produces a family of multilingual Windows word-processing and Internet products. He keeps in touch with **Dave**, '84, and **Heidi**, '84 (**Brun**) Goldfarb.

That's a wrap for '95. Best wishes to all for the holidays and for a happy and successful '96. And when you're putting those gift lists together this year, don't forget the Class of '81 Room 10-280 renovation project. The gift that keeps on . . . well, you get the idea.—**Mike Gerardi**, secretary, 3372 Olive St., Huntington Park, CA 90255; tel: (213) 587-2929 (h), (310) 203-8080 (w); fax: (310) 203-0567; e-mail: <mimg@jmbm.com>

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Gary Fedder finished a PhD in micromechanics at Berkeley in August of last year and immediately headed to Carnegie Mellon University where he is an assistant pro-

fessor holding a joint appointment in ECE and the Robotics Institute. Cheryl and Gary plan to build a new house on a $3/4$ acre plot near Churchill, nine miles east of Pittsburgh. . . . **Bob Powell** is working on information-access tools in Microsoft Network (MSN), and enjoying the company of John Fearnside, '87, Miguel Hall, '95, who is presently an intern in his group, and Russ Siegelman, '84, who leads MSN. At home, he finishing a DIY garage/shop addition that makes the home-shop space equal the rest of the house in size. As if it should be any other way! The space is dedicated to assembling the tools and skills and rediscovering the engineering states-of-art of the 19th century.

John Lucassen has been with IBM Research since 1990 after working for IBM in Tokyo and for McKinsey in Amsterdam and New York. His current responsibility is improving the R&D management process at IBM. He is single, and enjoys in-line skating (Central Park, NYC), and hiking. Finally, he would like to get in touch with any MIT alumni/ae who have taken the Landmark Forum. He can be contacted via e-mail: <jmlucassen@aol.com>.

Please send class notes to: **Helen (Fray) Fanucci**, secretary, 502 Valley Forge Way, Campbell, CA 95008; e-mail: <fangroup@aol.com>

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Norman L. Fortenberry has been appointed to the position of executive director of the National Consortium for Graduate Degrees for Minorities and Engineering and Science.

Norman received SB, SM, and ScD degrees all in the Department of Mechanical Engineering at MIT. He is currently employed at the National Science Foundation.

We actually received a type-written letter from a classmate this month (it's been so long I didn't know what to do with it!). The letter was from **Eileen Seligson (Janowsky)**. Eileen reported on her July 31, 1994, marriage to classmate **Steven Janowsky**. Eileen and Steven renewed their acquaintance a year before our reunion at another MIT wedding. They decided to go to our 10th Reunion together and were married last summer. They are living in Austin, Tex., where Steve is on the faculty of the Department of Mathematics at the University of Texas. Eileen is practicing law. Attending the wedding from the Class of 1983 were **Rob Varkonyi**, **Jonathan Weitsman**, **Rick Larkin**, **Betsy Pollack**, **Jerri-Lynn Scofield**, **David Rosenblitt**, **Dean Potashner**, **Sara Henderson**, **Susan Strausman Rietti**, **Ellen Frederiksen Nepustil**, **Dominic Pappano**, **Sara Weber**, and **Kathi Menne Livas**.

Please keep those cards, letters, and faxes coming!—**Jonathan M. Goldstein**, secretary, c/o TA Associates, High Street Tower, 125 High St., Suite 2500, Boston, MA 02110; fax: (617) 574-6728

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Itsy bitsy update this month. Geez, it's feast or famine in this Class Notes business!

I did get an update from **Roy Turnbull**. Roy is senior project engineer at TRW

Vehicle Safety Systems, Inc., where he is

responsible for occupant protection performance of air bag systems. "I have a 3-year-old daughter, **Brianna**, who is very cute! We live with my beautiful wife, **Theresa**, and two dogs, **Ginger** and **Cody**." Thanks for the update, **Roy**.

Congratulations to **Peter Merkle**, who recently received a PhD in civil engineering from Virginia Polytechnic Institute. Peter is working as senior member of technical staff at Sandia National Laboratories.

I also got a note from the ever-traveling **Joe Schmendrick**: "Got back from my safari in Africa. No white elephants. But I did get to see some zebras fending off an attack from a lion. Better than any Steven Seagal film I've ever seen. Now we're off to Indonesia to analyze some ash from Krakatoa recovered from a swamp there. We're looking for traces of organic material to see if there's any truth to the myths about the ancients sacrificing virgins to the gods by throwing them into the volcano. Now, *that's* forensics! I'll keep you posted."—**Jonathan Miller**, secretary, 1708 Plaza Ct., Mountain View, CA 94040; tel: (415) 961-2394; fax (415) 813-1130; e-mail <logiduke@aol.com>

ClassNotes

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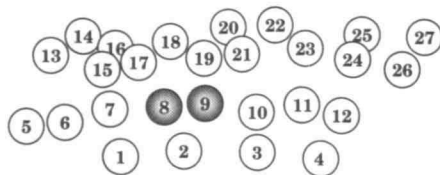
Apologies for the late delivery of the news in the first part of this column. Intended for the July issue, I've now learned that it didn't reach the *Review* office via e-mail and so is only now being brought to light.

Alec Atkin writes in to describe his drab and dreary life. "I am still stationed in Tokyo working for Hayes Wheels International. We make aluminum wheels for the automotive industry. I'm a sales engineer and CAO (that's chief apologizing officer). Actually, I don't apologize as much as I used to. Our quality is getting a lot better. I'll be in Japan until mid-March when I will be repatriated to the USA. That'll give me about 5.5 years total in Japan (2.5 for Hayes). I've applied to B schools and hope to attend somewhere in the fall. Since I last wrote in, I've been to South Africa and Zimbabwe on vacation. I did the safari thing in



ALPINE, N.J., JULY 1994— (All are '83 unless otherwise noted): [1] **Rob Varkonyi**, [2] **Jonathan Weitsman**, [3] **Rick Larkin**, [4] **Glenn Barest**, '84, [5] **Howard Benjamin**, '82, [6] **Betsy Pollack**, [7] **Jerri-Lynn Scofield**, '83, SM '83, [8] **Eileen Seligson Janowsky** (bride), [9] **Steven Janowsky** (groom), [10] **Laurie Goldman**, '84, [11] **David Rosenblitt**, '83, SM '84, PhD '91, [12] **Jocelyn Jacknis**, '81, [13] **Dean Potashner**, '86, SM '86, [14] **Renard Roy**, '84, [15] **Sara Henderson**, [16] **Susan Strausman Rietti**, [17] **Kevin Lam**, '85, [18] **Brian Moran**, '85, [19] **Ellen Frederiksen Nepustil**, [20] **Vladimir**

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Zimbabwe and it was incredible. The amazing part wasn't so much all of the wildlife as (the fact that) I was in the same Land Rover as J.R. Tracy, '84, and his wife, Liz (Sloan). Small world, I'd say. In May and August of this year, I used up some of my frequent-flyer tickets and flew off to Italy to visit my girlfriend. We went down to Croatia for a couple of days in May and liked it so much that we decided on another week in August. There wasn't any fighting in the area but we did see a couple of U.N. convoys. Recently over Christmas vacation, my girlfriend and I flew to Bangkok and then to Cambodia to see the ruins at Angkor. Angkor is absolutely an amazing sight, especially considering that the temples were built from the 9th to the 14th centuries. The Khmer Rouge weren't attacking anyone at the time so the danger was relatively low. We just couldn't walk around after sunset. We did see a lot of military riding double on motorcycles carrying bazookas and machine guns. A few months ago, I took a day off from work and did some modeling for Kadoya, one of the largest motorcycle leather companies in Japan. I happened to have a friend whose friend was looking for a 180-cm-tall, 70-kg blond foreigner who rides motorcycles to do the modeling. I fit the bill and got the job. I'm on the company catalog and in the advertisements in *Mr. Bike* and *Goggle* magazines. My brass rat can be seen in a couple of the pictures."

Vince Young also brings us up to date. "After reading enough of the class mail on my computer it is finally time that I contribute something, especially with the 10th Reunion coming up. To catch up a little, after MIT I spent seven years in California at Stanford in the MD/PhD program—the PhD was in microbiology. After finishing up at Stanford, I missed the snow so much that I decided to come back to Boston to do my residency in internal medicine at MGH. In the fall I will be staying on at MGH to do a fellowship in infectious disease, after a year of clinical work I will start my lab work. I have set up to return to the 'womb' and I will be working in the MIT Division of Toxicology on the little-known (but interesting to, at least, me and my advisors) bug called *Helicobacter hepaticus*. On the more interesting side, I will be getting married in October. My fiancée, Davoren Chick ('86—the red brick school up the river), is also in her last year of residency at MGH. Unlike me, she has the courage to stop training and to get a real job. She will be starting her practice here in Boston."

From first time correspondent Larry Kolodney: "It's been quite a convoluted path that I've taken since I finished a master's in Course VI-A in January 1987. After leaving MIT, I spent three months in Norway, working for a small software start-up that eventually folded without producing a marketable product. That was my one and only experience as a full-time programmer after graduation. I returned to Cambridge in fall 1987 to attend Harvard Law School (but not to study patent law!). I didn't give up my travel bug though, I spent the next summer in South Africa, working for a local anti-apartheid human rights organization in Johannesburg. Interestingly, I found Harvard Law School, for all its daunting reputation, to be far less challenging than MIT's undergraduate program. After law school, I spent a year clerking for a state court judge in Boston, and then took a job in a small New

York City labor and employment law firm. After three years, I returned to Cambridge last fall to do yet another clerkship, this time for Federal District Judge Nancy Gertner. I'll be doing this through summer 1996. After that, who knows?"

Josh Marantz also pipes in, "I'm writing to tell you that after 8.5 years at Viewlogic Systems, I'm finally moving on! On Monday, March 13, I'll be at Virtual Machine Works, an EDA startup (not competitive with Viewlogic) in Kendall Square, Cambridge. (Yes! My commute goes from 45 minutes to 5!)" . . .

Dan "The Man" Weidman tells us, "I will be getting a PhD in EE from the University of Maryland/College Park on May 19. I'm currently looking for a job. :-/ View my resume at <<http://www.glue.umd.edu/~weidman/>>." . . . In the procreation department Megan Donahue and Mark Voit (Princeton '83) announce "the birth of our first child, Michaela Rachel Donahue Voit. She was born on the coldest day this winter in Baltimore, on February 5, 1995. Michaela and Megan are doing fine, although Megan is looking forward to four straight hours of sleep eventually!"

Send news to: Bill Messner, secretary, 5927 Alder St., Pittsburgh, PA 15232-3890; tel: (412) 361-4180; fax: (412) 268-3348; e-mail: <bmessner@cmu.edu>; or Class of 1985 list-serv: <mit1985@mitvma.mit.edu>

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10th Reunion

Thanks to all who helped us
beef up the content of our '86
Class Notes column. Even the

secretary of another graduating class dropped me a note to comment on our increased content. We aim to please both our analog and digital readers, and feedback from fellow classmates about our new "online" format have been quite favorable. "Great Idea. Look forward to seeing/hearing more." (S.K., Atlanta, Ga.) "Nice Job." (M.W., Lowell, Mass.) Please note, if you use e-mail for your submissions, your news is NOT immediately sent to the entire mail list. Only the final edited column is sent out to the class.

Dan Schmauch writes that he and his wife, Kathy, are enjoying life in Fort Collins, Colo., with their two sons, Kyle (3) and Ryan (1). "When we aren't chasing the boys or visiting family in Montana, we're likely to be camping somewhere in the vicinity of Rocky Mountain National Park." To fund his fun, Dan is working at Hewlett-Packard, managing a marketing group of customer-support engineers, and striving to ensure that HP's customers' custom-integrated circuits get to market quickly and correctly the first time, with enough capacity to ensure continued rapid market growth. "Those of you not in the semiconductor business would be amazed at what we can produce on a square centimeter of silicon these days, a square millimeter for that matter."

Win Treese works for Open Market, an Internet commerce start-up in Cambridge. He passed along several interesting bits of technology trivia. Venture capital invested in Internet companies, first quarter 1995: \$47 million. Venture capital invested in Internet companies, all of 1994: \$42 million. Number of PBS stations with World Wide Web home pages: 25. . . . Mark Wolf is currently a product line man-

ager at M/A-COM (just recently acquired by AMP) in Lowell, Mass., where he runs a \$35M business. "My group is expanding at a tremendous pace, since we service the cellular market, so if there are any analog engineers out there, they should contact me." Mark's still single, but has recently decided to move in with his girlfriend. He keeps in touch with **Leon Liem**, a surgeon in Maryland, who is married to wife, Miko, and has a daughter, Stephanie.

David A. Guterman writes from Brookline, Mass., that he's started work with Stellar Financial Systems of Wayland, Mass., to market their Mercury Derivative Optimization System. It breaks down complex/exotic equity derivatives into primary components (puts, calls, bet call). "Our own newest derivative is Ariel Gourgia Guterman, born August 14, 1994, in Boston. She is generally fun, amazing, and astounding (and does card tricks)." His wife, Karen, is starting a research project on gene therapy for neurofibromatosis (Elephant Man's disease) in the Neurogenetics Lab at Mass. General Hospital in Charlestown.

We now interrupt this program for a commercial announcement from our sponsor: Our 10-year Reunion is taking place next year, June 6-9, 1996. (Can you believe it's been almost 10 years?) In '96, reunion weekend and commencement weekend will be combined. The plans are still being put together for the specific class-related activities, but when you're blocking the time out on your calendar, consider the following tentative schedule:

Thursday, June 6: Tech Night at the Pops.

Friday, June 7: Commencement, possible sight-seeing tours planned by MIT, Class Event?

Saturday, June 8: Technology Day, campus-wide evening event, or a Class Event?

Sunday, June 9: Class Breakfast, Challenge Games, Tex Bar-B-Q.

This announcement was paid for by our Class President **Mary Ystuetta**. Anyone interested in working on the reunion or being reunion chairperson should contact Mary at (508) 521-2433 (h); (617) 221-5163 (w); or e-mail: <mcy@e4450uxm.esr.hp.com>. Now we return to our regularly scheduled programming.

In other news from Mary, she changed companies in December and now works for HP at their Burlington Sales Office teaching Unix, C, and C++ to HP customers. "I love my job but it doesn't give me much free time. I'm typically in a classroom from 8 a.m. to 5 p.m. most days and spend the time before and after class catching up on the days mail and messages. Still the work load is a lot less compared to my old job with a small object-oriented training and consulting firm." In addition to work, Mary has become an avid horseback rider. "I bought a quarterhorse three years ago, which is now working as a State police horse in Mass. 'Pierre' goes to parades, patrols state and city parks (such as the Esplanade), and even gets to go to Patriot games." Mary is currently leasing a thoroughbred, Zodiac. (Even horses can be leased!)

Tom Kurfess in Atlanta, Ga., and his wife, **Adriana**, '87, had their first child, **Rebecca Ann**, on June 20. Both she and Adriana are

doing well—Rebecca has even started sleeping through the night. "We are quite excited about our new daughter and are looking forward to many years of fun with her." On a more professional note, Tom has just been informed that in November he will receive the 1995 American Society of Mechanical Engineers Pi Tau Sigma Gold Medal Award for Outstanding Contributions to the Field of Mechanical Engineering. "I am quite honored by this award as only one is given out per year." The award is in recognition of Tom's research and teaching in mechanical engineering, in particular, system control and precision manufacturing. Tom is currently associate professor in mechanical engineering at Georgia Tech. . . . **Chris Kim** and his wife have moved from Pittsburgh to Washington, D.C., where

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Chris is starting his second year of a gastroenterology fellowship at Georgetown. "Medicine is eternal training: The more you learn, the more you realize how much you don't know."

Lee Newberg is living in Naperville, Ill., and is working at the University of Chicago on World-Wide-Web-based educational software for teaching biology to undergraduates and high school students. One of his current projects will allow students to take their own DNA sample and compare it to those of their classmates and other people around the world. He is also working on a project to integrate the Web with object-oriented multiuser domains (MOOs) and their ilk so as to produce software that has the hypertext and multimedia features of the Web and the interactivity and programmability of MOOs. Lee's wife, **Heidi**, is an astrophysics postdoc working at the Fermi National Accelerator Laboratory on the Sloan Digital Sky Survey. "In our spare time we moonlight as foster parents." As of July, they are currently caring for a 14-month-old girl named **Michelle**. Lee recently got together for dinner with **Steve Callaghan**, **Hal Cohen**, '87, **Brecht Isbell**, '91, in Naperville. A fun time was had by all.

Beng-Hong Lim got married in August '94, and completed an MIT PhD in EECS in October '94. **Toon-Soon Lee**, a trader in Manhattan, and **Choon-Huei Seow**, '90, currently pursuing an MBA at the University of Chicago can be seen in the wedding photo. Other MIT alums at the wedding were **Mike Haungs**, **Christine Hao** (Chan-Lizardo) and her husband, **Eric**, '87, **Warren Tong**, **Mandy Ng**, and **Roger Zee**. Warren is working in real estate in Manhattan, Mandy recently moved from a position at DEC to State Street Bank in Quincy, Mass., and Roger is moving up through the ranks at DEC in Littleton, Mass. As for **Beng-Hong**, he is now with IBM Research in Yorktown Heights, N.Y., doing research in parallel processing. "It has been quite an exhilarating and refreshing change, making the transition from single to married life, and from academia to industry." His wife, **Angela Chang**, received a PhD in economics from MIT in '93. She works at the Federal Reserve Bank of New York.

Ramon San Pedro writes from Houston, Tex., that he and his wife, **Sylvia Perez**, '88, were expecting their second child for the end of June. Their daughter, **Alyssa**, is almost four years old. . . . **David Cultice** is taking nine weeks this summer to bicycle tour across the United States from Seattle to Washington, D.C. He intends to take plenty of pictures. . . . **AnnaLisa Fear** still lives in Oakland, Calif., and works at Chiron Corp. in biological therapeutics research. On May 15, she and her husband, **John Goodwin**, had a son, **William Foster Goodwin**.

Keep those letters and e-mails comin' on in so we can maintain our newly-gained leadership position in quality and content.—**Bill Hobbib**, secretary, 5 Cappy Cir., West Newton, MA 02165; e-mail: <mit1986@mitvma.mit.edu> or <billhobbib@aol.com>



THE PRINCETON UNIVERSITY CHAPEL STEPS, with the wedding party of **Beng-Hong Lim**, '86 (3rd from right) and his bride, **Angela Chang** (Princeton '89). From left are attendants **Choong-Huri Seow**, '90, **Sook-Hee Lee**, **Josephine Iacuzzo**, and **Tong-Soon Lee**, '86.

The news for the August/September issue has now emerged from cyber-limbo and will find its way into this column. But, first things first.

I mistakenly identified classmate **Anthony Joseph** in the July column as "Anthony Irving." My apologies for letting that one slip through.

As far as **Lenny Rubin** can remember, his name has not yet appeared in our Class Notes since graduation, so he is remedying that situation with a brief summary of how he has spent the past eight (eight!) years since graduation. After finishing a PhD in electronic materials at MIT in 1992, Lenny headed out to Boise, Idaho, to do process development for a small semiconductor company. As the recreational opportunities around Boise are among the best anywhere, Lenny spent weekends hiking in the mountains and in the desert, rafting, and cross country skiing. The high point (literally) of his adventures was his ascent of Mt. Borah, which, at 12,662 ft. is the highest point in the state. The climb was extremely challenging, but the views were worth it. After hearing, though, for the hundredth time, "what a big change Idaho must be after living in Boston," Lenny began to wonder if these people might have a point. In February, Lenny moved back to the Boston area, and is now working for Eaton Semiconductor Equipment in Beverly, Mass., as principal scientist in the area of technical marketing. His main responsibility is to study ion implantation processes in silicon, and he finds it challenging to work in the marketing area after years in engineering.

Rob and Greer Tan Swiston are proud to report that they are the new godparents of Marisa Ming Wang, born April 23, 1995, to Greer's sister Grace Tan-Wang, '86, and her husband Jeff Wang, '86. . . . Also, some exciting news from **Kesevan Srinivasan**—he is marrying Heidi Martin (sister of **Scott Martin**) on June 3, 1995, in Hudson, Ohio.

Denise (Neirinckx) Sacha is proud to announce the birth of Julia Marie Sacha on April 8, 1995. Dad (Dennis Sacha, '84), mom, and baby are doing fine. Denise is currently on leave from the Navy Public Works Center, where she was designing HVAC systems and contracting with architecture and engineering firms. They are looking forward to the 4th of July at Virginia Beach, where a lot of '87ers will be getting together at the Sacha's beach house for a big Independence Day blowout! (Hope all those who attended write in with lots of details.)

Paul Sidhu and Sean Amberg went skydiving last summer near St. Louis, Missouri. Paul is moving to St. Louis late this summer to work for Monsanto, after finishing an MBA at Sloan. His wife, Nancy, finished a PhD last summer, and they had a lovely daughter Natasha Kaur, who was cooperative enough to delay her debut until after final exams last December.

Reed Steinmetz writes: "In June 1994, my wife, Jennifer, and I moved to Danville, Pa., from Edison, N.J. I am still working for Merck and Co., in their Manufacturing Division. I am responsible for the design and implementation of batch process control systems, including data acquisition and data analysis applica-

tions. My wife is working as the associate director of financial aid at Susquehanna University. We our bought our first home, a 175-year-old house in the historical district of Danville, which is in excellent shape despite its age. Danville is a welcome change after the hectic fast-paced New Jersey lifestyle." Reed concludes by asking all of his fellow '87/'88 chemical engineering/Chem E Practice School graduates to write in and let everyone know where they are and what they are doing.

Bradley Feld has recently invested in and is chairman of an Internet-related startup company, called net.Genesis (<http://www.netgen.com>). net.Genesis is developing server-side tools for the Internet, and was founded by four MIT graduates, who participated in the MIT/David Morganthaler \$10K Business Plan Competition. net.Genesis was one of five finalists out of the 45 total entries. Brad served as a competition judge. Also at MIT, Brad was the project manager for the planning project for the new MIT Entrepreneurship Center. MIT is working on the development of this center, which will be located at the Sloan School, and which will be available to all faculty and students on campus. (Any interested parties may contact Brad at <bfeld@feld.com>.) In addition to his work with MIT groups, Brad was recently elected to the board of directors for the Dartmouth Entrepreneurs Society, as well as the board of directors of SBT Accounting Systems. The latter is a \$15 million accounting system firm located in San Rafael, Calif. Their latest product, SBT Pro Series 3.0i, is the first Internet-enabled accounting system.

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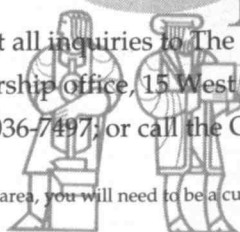
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Craig, '84, and Rhonda (Fullerton) Reynolds had another baby girl this past March 15th. Colleen Amanda joined sister Jocelyn (born July 1993) who is ecstatic about her baby sister and has become quite the "little mother." Rhonda has been working as a production manager in Boeing's Fabrication Division in the Machining MBU since graduating from the MIT Leaders for Manufacturing Program in May 1994. She enjoyed her two years back at the 'Tute, and now finds that she misses Boston. She and Craig are quite happy in Seattle, though, and expect to stay put for a while. Rhonda expects a visit from Patti Sherman this summer, who is doing a post-doc in human genetics at Johns Hopkins. Patti received a PhD from the University of Michigan about two years ago.

Back in Boston, Jerry Hershkowitz knew exactly what to do the first weekend in May: Go to Senior House Steer Roast. Actually, not being a resident of Senior House, it took the prodding of Jonathan Root to remind him of the event. Jerry expected to see lots of old friends there (which he did) from East Campus, Senior House, and from his days as captain at Pritchett. Tom Wethern was there. It turns out that he works just down the road from Jerry at a/d/s as a chief acoustician. Andy Muenz was there (not surprisingly) and provided this quote: "I'm living proof that an MIT education is no guarantee of a job." Craig Rodgers, '88, drove in from Jacksonville; he has been spending time leading Outward Bound outings to various places. (He thought that he had his old "Mike Siemers" shirt with him in the car, but could not find it. They did have a laugh over them, though.) Other people who were there include Tiffany and Mike Quintana, '89, and Ralph Ganska. Mike is back at the 'Tute, working on a PhD in nuclear engineering, while Ralph is enjoying life out west in Salt Lake City, where he is on assignment for Draper Labs. At work, Jerry has renewed his friendship with Mike Judy. The two of them worked on their SB thesis together in Professor Stephen Senturia's (PhD '66) lab. After completing a PhD at Berkeley in 1993, Mike joined Analog Devices, and works in the same office as Jerry does.

Julie Marquette started her internship in family medicine at the University of Washington last summer. When she has time to come up for air, spends her time at two new sports: mountain biking and kayaking. . . . Blake Leverett is working for the Super Flow Corp., where he is designing equipment for engine, vehicle and emission testing. He and his wife, Sarah, have two little boys.

Well, that's it, for now, and keep me posted!—Jack Leifer, secretary, 2908 Roses Run, Aiken, SC 29803; tel: (803) 642-3900 (home), (803) 648-6851 (work); fax: (803) 642-2700; e-mail: <leifer@scarolina.edu>

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I hope you have a good Thanksgiving.

Charlie Hong's wife, Stephanie (formerly, Sun Choi) '87, gave birth to identical twin girls, Katherine and

Sarah, on March 26, 1995. Katherine and Sarah look just like Emily, their 3-year-old firstborn, when she was a baby! Charlie has set the record for having the most children (3) while attending Yale Medical School.

Charlie has had time on his side since he is on the MD/PhD track. . . . Steven Cohen and wife Merle had a baby boy, Daniel Elias Cohen, born on May 16. . . . The last news of Kimberly Thompson and Kamran Badizadegan to appear in this column was their marriage announcement several years ago. In 1993, Kamran graduated from Harvard Medical School (HST) and began a residency in pathology at the Brigham and Women's Hospital in Boston. Two weeks into his residency, their daughter, Deanna Maris Badizadegan, was born. Following Deanna's arrival, Kimberly decided to stay home and finish doctoral work in environmental science and engineering at the Harvard School of Public Health on a part-time basis. She defended her thesis in January, two weeks before the birth of their son, Nima Daniel Badizadegan. In July, Kamran started a fellowship in pediatric pathology at the Children's Hospital. Kimberly loves taking care of the kids and consulting 10–20 hours/week out of their home in West Roxbury.

Kimberly also sent news about Lisa (Vingerhoet) Tung and Gene Tung who have stopped in for quick visits the past two Christmas vacations. They both finished PhD's from UC Berkeley and are now living and working in Pennsylvania. Lisa works at Rohm and Haas, and Gene works at Air Products. . . . Joycelyn (Valderrama) and Dave Koehler, '87, and their baby Kristen moved from Boston to San Antonio, Tex., in July. Dave will be stationed at Brooke Army Medical Center at Fort Sam Houston. Before they left, we had a good-bye picnic in Killian Court. Bob and Sheila (Neville) Flory, Dave and Nancy (Perugini) Riggs, and Andy and I were there.

Lon Sunshine was recently promoted to captain in the Army Reserve. . . . Paul Beckmann and his wife, Chin, were at the annual "MIT DSPG bluefish" picnic that I attended. They

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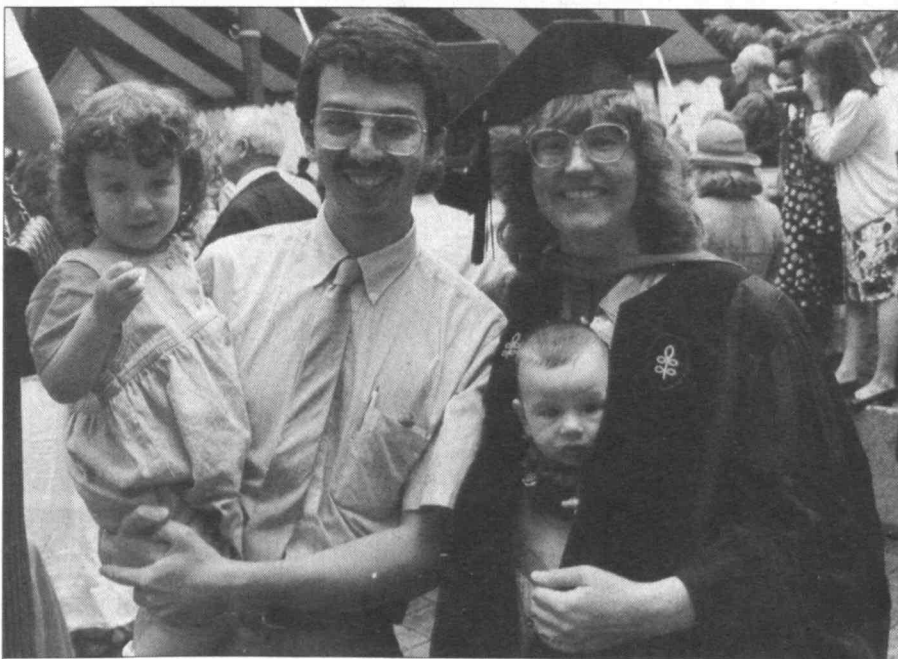
brought their son, Eric, who had just turned one. A Chinese tradition is to place many objects on the floor on a child's first birthday and to see which one he picks up first. Eric passed up the money, the lipstick, and many other items as he went straight for the calculator. . . . Aimee Burstein just received an MA in clinical psychology and will be certified as a school psychologist soon. In a recent trip to San Francisco, Aimee saw Bill Chapp and his wife, Dili. Aimee has also seen a lot of of Arlene Bernhardt and her husband, Marc, since they also live in the NY metro area.—Catherine Suriano Singer, secretary, 131 Main St., Andover, MA 01810; e-mail: <singer@mit.edu>

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Greetings! I received mail in many forms this month: fax, mail, and e-mail, so please keep writing and typing, and thanks to everyone for sending in news this month! This

month's list of people we would like to hear from includes Paula Aquí, Paolo Diaz, Michael Sheda Ho, Hyo Kim, Marjorie Oleksiak, Leanne Sterbank, and Andreas Villarreal. What are y'all up to? If anyone knows about any of these people or anyone else, please write in.

A few more members of the class have home pages, including Barry Margulies and Vincent Chau. I'm now maintaining a list of '89ers who have home pages. Barry writes, "I haven't had much time to work on it recently (I've only recently learned HTML)." . . . K. Tibor Toth recently moved back to Boston and is



Kimberley Thompson, '88, her husband, Kamran Badizadegan, '88, and their children—daughter Deanna Maris and son Nima Daniel—at the Harvard School of Public Health graduation ceremonies last June.

working for Lee Capital Holdings, an investment firm specializing in management buyouts and growth capital investments. He and his wife, Jennifer, recently bought a house in Framingham and are proudly raising their first child, 19-month-old Alexander. . . . **Matthew McCarty** moved to Virginia, where he is now working for Lockheed Martin.

Cindy Wang went on a tour of Europe, meeting up with boyfriend Steve Chao (Harvard '90), at the end of his 18-day concert tour of England and Scotland. In London, Cindy caught some plays and visited Buckingham Palace. Then, onto Paris where both visited "the biggies"—Eiffel Tower, Arc de Triomphe, Louvre, etc. We got to the Louvre late in the day, found the *Mona Lisa* (geez, it's soooo small!), found the *Venus de Milo*, and then promptly found a bench. Next, we were off to stay with my friend (a former postdoc from my lab) in Basel, Switzerland, then, Zurich, where we checked out all the major chocolate confectioneries and even went to the Lindt museum! We made an overnight trip to Interlaken." As soon as Cindy returned to Boston, she was all set to leave for a family reunion in the Banff/Jasper/Lake Louise area of the Canadian Rockies! "Don't even ask how research is going!" Earlier in the summer, Cindy was able to attend Tech Day and reunions with **Alison Miyamoto**, **Marlene (Lamas) Cullum**, and **Laura Brauer**. Many were in town for an informal McCormick Fourth West reunion. Marlene and husband Mal have a daughter, Emily.

Karl Dishaw left the Air Force in January and started at TRW Space & Electronics as a

systems engineer. **Karen Koyama** put Karl in touch with her old boss there, which helped a bunch. Karen just graduated from Stanford with an MS. . . . **Nat Seymour** just joined TRW also, and Karl and Nat have caught up some. "First time we'd seen each other in five years," Karl writes. "I've also talked to **Kia Freeman** and **Julia Hsieh**, who're also working in the LA area."

In June, **Teri Centner** attended her first MIT Club of Northern California meeting. "It was fun, but quite a drive for a weeknight. (All the good stuff happens in the Bay Area.)" Teri ran into **Scott Fullam** and **Angeli and Bill Maney**.

During July, Teri spent a week in Hawaii. "I stayed with a friend at Hickam AFB and did the tourist thing all over Oahu. I even found MIT friends there! At lunch, my friend Diane ran into two Navy guys who had come over from Pearl Harbor to eat at the Air Force Base. One of them was **Sean Findlay** and the other was **Steve Kirk**, '90. Sean is stationed on the SSN *Bates*. He is out of port quite often, but when he is home, he lives on a 35-foot sailboat. I guess that's why he hasn't been getting his *Tech Review*. Apparently **Roger Horton** is also stationed at Pearl Harbor these days, but I didn't get a chance to see him. I was able to hang out a lot with AFROTC pal and Sigma Kappa sister Heather "Goo" Morin, '91."

At the end of September, the Air Force will be moving Teri to Northern Virginia. "I'm switching careers from aero engineering to computer systems officer," Teri writes. "I have no idea if I'm qualified for this job, but I'll let you know after I get there!"

James Wordon was married to **Anita Rajan**, '90, in a traditional Hindu wedding ceremony in June. Actually, there were two wedding ceremonies and three receptions. James and Anita, who as undergraduates met while working on the MIT solar car, went on to found *Solec-tria*, a manufacturer of electric vehicles, in 1989. **Brian Vogel** is now senior VP at Product Genesis, Inc., a Cambridge firm that was recently featured in the *Wall Street Journal's* Form & Function section, a column that regularly features innovative new products where design plays a significant role. The article featured Stanley's hammer, which sports a new grip designed with Product Genesis.

Laura (Ryzowicz) Rapacioli writes, "My husband, Mark, '87, and I are thrilled to announce the birth of our second child. Samantha Rose Rapacioli was born on June 19, 1995, weighing in at a petite 6 lbs., 11 oz. She joins big brother Dominick, who just turned 3 on June 23." Laura just finished a second year at Pace University School of Law. She says, "I have two more years to go in the evening program. I am enjoying law school tremendously (except maybe around finals time) and hope to specialize in environmental law. This summer I have been working for a professor doing research on the Clean Air Act."

"I always enjoy reading the alumni/ae news column because it's a great way to find out what people have been up to and reminisce about good times at MIT. I hope to attend some of the reunions in the next few years and hopefully reconnect with some people with whom I have lost touch over the years."

Sheryl and Ron Dagostino gave birth to

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their first child—a son, Eli Michael Dagostino—on July 10. Ron writes that Eli “weighed in at 7 lbs., 7 oz., and 19 3/4 inches, and he has red hair like his dad. I just completed my MBA from Northeastern University, and I’m still working at Fidelity Investments doing computer programming here in Boston. I have no major career changes planned. I learned a lot in the MBA program, but I like what I’m doing, so why change? Sheryl and I still live right downtown; life with a baby in a one-bedroom apartment is interesting to say the least, and we’ll probably make the move to the suburbs next year.”

Well, that’s it again for this month. Please send in news!—**Henry Houh**, secretary, 4 Ames St., Cambridge, MA 02142; tel: (617) 225-6680; fax: (617) 253-2673; e-mail: <hhh@mit.edu>; World Wide Web: <http://www.tns.lcs.mit.edu/mit89/>

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Please send news for this column to: **Max Ochoa**, secretary, tel: (415) 437-6902; e-mail: <mchoa@leland.stanford.edu>

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5th Reunion

CHANTS DE TERRE ET DE CIEL may mean “songs of the earth and the sky” to someone with

high school French. For **Deborah Kreuze** and **Dan Schmidt**, however, it means something more. The pair are preparing a vocal recital of that piece by Olivier Messiaen. Last spring, Deborah began the full-time studio art program at the School of the Museum of Fine Arts in Boston.

Chants de terre: **Jason Slibeck** is finally going to be shore-bound, after years in the Navy. Jason, his wife, Sarah (Wellesley ’91), and I recently got together in Harvard Square for a night at the House of Blues. He and Sarah now live in Manhattan. Jason is leaving the Navy “after two ships, two deployments, and 20 of the last 24 months at sea.” He is very excited to begin life as a civilian and promises to grow his hair long. As we shared stories, Jason took some time to write me some notes about his fellow SAEs on the back of a cocktail napkin. **Tom Fahy** is “gigging with a band in NYC, singing the blues.” **Chris Masalsky** and his wife, Amy Franz (Wellesley ’91), just had a baby girl this winter named Ellen Pember Masalsky. **Jason Oliver** married Kathy Stevens (Simmons) this spring and “spent a gorgeous honeymoon touring Arizona and the Grand Canyon.” **Dave Mercer** is enjoying life in Los Angeles. **Mike Brown** married Debbie Wardlow (Boston College ’91) before honeymooning in Ireland. “Mike is now ‘Dr. Brown’ and will be interning at Cleveland Clinic.” **Matt Long** is seeking a position teaching and coaching wrestling, and has August wedding plans. **Henry Dotterer** left Motorola for an eight-month world tour in March. Just before he left, his car was wrecked. Writes Jason (on a cocktail napkin, mind you), “Ostensibly an independent study of emerging automobile markets, Henry’s tour is financed by the insurance payoff from the destruction of his own automobile!”

Chants de ciel: **Jacquelyn O’Byrne** has

enjoyed the last year in Hawaii, working on an MBA and as a research assistant. On weekends, she skydives. “My latest project,” she writes, “is planning my wedding to Geoffrey Grizzard (Air Force, ’90) in April 1995.”

Chants d’eau: **Riad Bsaibes** lives in Dubai, Arab Emirates. He is the lead engineer on the *Big Orange 25* (Schlumberger Dowell), which is an oil-field simulation vessel operating in the Arabian Gulf. “Plenty of fish, adventure, and excitement,” writes Riad, “I bumped into Shervin Limbert, ’94, by sheer coincidence in a mall. It took us a minute of staring until we both asked, ‘What are you doing here?’”

Plus chants de terre: **Ken Shimberg** sends a postcard from the Grinnell Glacier, in Montana. Ken and his wife, Betsy, have enjoyed taking a few of their recent vacations in America’s West. Last year they rafted down the Grand Canyon and skied in Utah. Ken is still at J.P. Morgan, but is now a member of their Structured Finance Group. Ken and Betsy are looking forward to their planned move across the East River to Brooklyn Heights.

Une autre chante d’eau: **Melissa Norcross** is living in Cambridge, England, where she works for a management consulting firm.

“Have been in England for the past year and a half and loving it!” writes Melissa. “My rowing team, The Sons of the Beach, is competing in the World Master’s Championship in Bled in September.”

Chants d’argent: **Mark Kaufman** was recently named “stock fund manager of the month” by *Businessweek* for his phenomenal prowess as manager of Fidelity’s select electronics fund.

Chants d’hiver: To help warm up the approaching winter, please send your summer news to: **Andrew Strehle**, secretary, 59 Commonwealth Ave., Apt. 4R, Boston, MA 02116; tel: (617) 450-0637; or by e-mail to **Renee (Mong) Miller**, <miller-rl@post7.laafb.af.mil>.

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Adam Riess is finishing a PhD in astrophysics at Harvard this summer and is living in Cambridge. He spent two weeks at a conference this summer north of Barcelona,

Spain. . . . **Daniel Wambold** is surviving med school in Philadelphia and hoping to be doing anesthesiology in Boston in 1998. . . . **Monte Frazier** and **Jeana Randell Frazier** were married in Stromsburg, Neb., in June.

I am sorry the notes are so short this issue. I just recently moved back to Colorado—Denver this time, and I am working on a master’s in architecture. I am finally back on line and you can now send me e-mail. Wow, I’ve been out of touch with The Net for three years! I definitely expect to hear from a lot more of you now. —**Leslie Barnett**, secretary, 2644 Vrain St. (Yes Vrain, not Brain), Denver, CO 80212; e-mail: <labarnet@ouray.cudenver.edu>

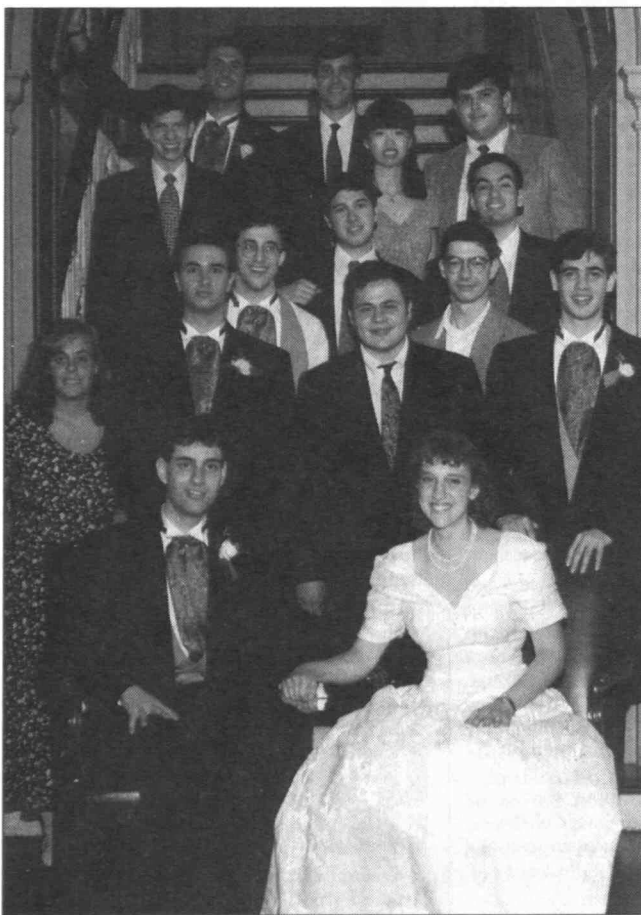
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After spending a year in New York City getting a master’s in journalism at Columbia, **Karen Kaplan** is living in Los Angeles, writing about entertainment and technology for

the business section in the *Los Angeles Times* and loving every minute of it. Karen often sees **Stella Park**, who just passed her qualifiers at UCLA, where she is pursuing a PhD in theoretical physical chemistry. She is really enjoying her research but is a little sad now because her boyfriend, Mike Lim, left LA to go back to



TEMPLE EMMANUEL, NEW HYDE PARK, N.Y., JUNE 1995—From left to right, top row: **Peter Goldstein**, ’95; **Yeval Koren**, ’94; **Andrew Begel**, ’96; **Barry Kostiner**, ’93; **Suzanne Green Burcat**, ’84; **Rafael Levin**, ’94; **Barry Green**, SM ’53; **Heather Kinner Greene**, ’95; **Andrew Greene**, ’91; **Jennifer Burke Gaunce**, ’93; **Laura Elsberg**, ’94; **Joseph Adler**, ’96; and **Douglas Shreiber**, ’95. Bottom row: **Mark Uhrmacher**, ’94; **Joseph Grossman**, ’93; **Jeffrey Reback**, ’94; **Jonathan Rosenberg**, ’95 (groom); **Michelle Greene Rosenberg**, ’93 (bride); **Ophira Segal**, ’96; **Igor Gonta**, ’95; **Eddie Garon**, ’95; and **Jordan Slott**, ’96.



URBANA, ILL., JUNE 1994—Left to right, back to front: Joshua D. Milner, '95; Edward H. Gornish, '86; Scott J. Smith, '95; Amy B. Chan, '93, SM '95; Edgar F. Hilton, '94; David A. Friedman, '96; Alan Mizrahi, '97; David M. Poppers; Michael J. Franklin, '88; Jill Depto, '97; Ari M. Lipsky, '94; Joshua D. Wise, '97; Ben Y. Reis, '95, SM '96; D. Benjamin Gordon, '94 (groom); Leah S. (Reingold) Gordon, '93, SM '94 (bride).

MIT for a doctorate in electrical engineering. . . . Seema Jayachandran just finished a two-year program in physics and philosophy at Oxford on a Marshall Scholarship. Last heard, she was headed to Africa for the summer unless the info she got about the Ebola virus from the CDC stopped her. She'll be came back to the States in August and will be working for a couple of years for McKinsey and Co. consulting in San Francisco. Then if she's still up for it, she will be going to Harvard for a PhD in physics. . . . Nancy Schondorf had a reunion in Boston with Wendy Vit and Leila Tabibian this spring. Wendy is at Duke working on a master's degree in environmental policy and missing the Boston music scene. Leila is in med school at USouthern California. We were not surprised to learn that she was her class social chair during her first year! Nancy is working in the Technology Licensing Office, learning about the more obscure business aspects of technology transfer. She says, "The Kendall Square/Tech Square area is the place to be! It is crawling with MIT grads."

Katy Evanco and Brian Brown were wed July 8, 1995. There were many AXOs and DKEs attending. The newlyweds are honeymooning in Ireland and have bought a home in Colorado. Hopefully they will send in some pictures. . . . Sarah Wheeler was working for two years for a biotech company in Cambridge but is tired of the working world and is going back to Wellesley to get trained to teach. . . . Emily Yeh is finishing up a master's in TPP and VI-1 and will be going to Beijing for a year starting in August with MIT's new MISTI program. Then she'll be going to Berkeley in fall '96 for a PhD in the Energy and Resources Group.

Mark Enstrom currently lives in San Jose and still works for Telecommunications Techniques Corp. The big part of his job is training people. He really enjoys that because he can be in front of customers a lot, learn about the networks that are going in the "national infrastructure," and still travel a lot. After two years with Microsoft, Jim Hansen took his money and ran back to school. He is now enrolled in the MS program and studying water resourcess with Stanford's Civil Engineering

Department. . . . After finishing a master's thesis at the USouthern California, Masahiro Arakawa has made his way back to Boston, where he is a staff member at Lincoln Laboratory. He is working on applying massively parallel processing to next-generation radar systems.

Lead Wey just received an MBA this June from Sloan School, and will be heading out to NYC to work for Booz Allen & Hamilton as a management consultant. For the past two years, he was working for a small transportation consulting company, and going to grad school at the same time. He also successfully started a software company.

Danny Su been working for McKinsey's Hong Kong, for about two years now and is sharing an apartment with his brother Steve. Actually he spends alot of time traveling. He has worked on projects in China, Thailand, and Taiwan. Next year, Danny plans to go to business school, either at Kellogg or Stanford. . . . Matt Olsen got married last June 24 in Connecticut. He works at Lingol. . . . Claudia

Hung recently switched from working for Boston Acoustics to Deloitte & Touche in Seattle. . . . Jen McMurray still works for Intel and lives in Phoenix. But she is currently on training in Portland, Ore. . . . Neel Sarkar recently switched from GE to Commonwealth Edison. He is starting an evening MBA program at Kellogg soon. . . . Eleni Kapogiannis recently transferred from Phoenix to Santa Clara.

Please send in your news for Class Notes to: Mari Madsen, secretary, 85 Alberta Rd., Brookline, MA 02167; or call (617) 469-3028; Sophia Yen, e-mail correspondent, <syen@itsa.ucsf.edu>

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Greetings! Once again its time for Class of '94 notes. I should note that my address has changed yet again, so please be careful where you send those letters and e-mail.

Our first news comes from LA-land, where Doris Lee and Jason Schense, unknown to each other at MIT, "have become terrific friends sharing the same floor of the Chemical Engineering Department at Caltech." Jason has developed an interest in motorcycles and can be seen "cruising around the LA basin on a Harley with way-cool sunglasses." This past summer, Doris ventured into the entertainment industry and "spent Saturday mornings directing the tram ride at Universal Studios." Finally, the two warn, "Our latest adventures involve being extras, so be sure to pay close attention next time you see a movie filmed in LA!"

Speaking of movies, Benjamin D. Schoon reports, "I now go by B. Durant Schoon. I'm working at Industrial Light and Magic (finished *Casper* a little while ago) and living in San Francisco, hanging out in Tuesday-night goth clubs."

From the East Coast, Funmi Oliyide reports that having recived a master's from Georgia Tech, he is heading to Rochester, N.Y., to work. . . . Christopher Adler sends news: "I am a graduate student in music composition at Duke University, entering my second year, and I just spent a month this past summer studying traditional music in Northeast Thailand."

Finally, Rich Downey writes from Pensacola, Fla., to report that, "learning to fly the T-34 in Navy flight school is sort of like learning to drive a 550 HP (that's horsepower, not Hewlett Packard for you Course VI types) race car on the Mass. Turnpike with Mario Andretti in the back seat yelling things like 'Why aren't we going straight,' or 'You're too far to the right,' or 'Weren't you supposed to take that exit,' or worse. It's sort of like that only in three dimensions instead of just two."

What's new with you? Met up with some '94ers? Been taking driving lessons with Mario Andretti? Completed another degree? Send me a brief note.—Jeff Van Dyke, secretary, 6000 Shepherd Mountain Cove, #1401, Austin, TX 78730; e-mail: <jvandyke@lcs.mit.edu>

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Please send news for this column to: Ranjini Srikantiah P.O. Box 514 Sandy Hook, CT 06482

CourseNews

CIVIL AND ENVIRONMENTAL ENGINEERING

Jared L. Cohon, SM '72, PhD '73, the dean of Yale University's School of Forestry and Environment Studies, was appointed to the Nuclear Waste Technical Review Board by President Bill Clinton. The board reviews storage sites and evaluates packaging and transportation of high-level radioactive waste and spent nuclear fuel. Cohon previously served as a legislative assistant for energy and environmental issues to Sen. Daniel Patrick Moynihan (D-N.Y.). He holds a BS from the University of Pennsylvania. . . . **Elvin R. Heilberg III**, SM '58, the president of Heilberg Associates, Inc., of Mason Neck, Va., was one of nine MIT alumni inducted into the National Academy of Engineering in September. Heilberg was cited for his professional and managerial contributions in civil, environmental, and space technology. . . . **Gabriel R. Toro**, SM '81, PhD '84, was promoted to VP of Risk Engineering, Inc., a consulting firm in Boulder, Colo., specializing in applied engineering risk analysis



Thomas Maddock

for major civil engineering projects. . . . **Tom Maddock**, SM '51, the president and CEO of Boyle Engineering Corp. in Newport Beach, Calif., was recently selected as a member of a new joint federal-state California advisory group that aims to develop long-term solutions to problems affecting the San Francisco

Bay and Sacramento-San Joaquin Delta Estuary. This Bay-Delta Estuary plays a vital role in California's environment and economy. In December 1994, the federal government and the state entered into a framework agreement that created the CALFED Bay-Delta Program. The Secretary of the Interior and the governor of California jointly selected the members of the advisory panel, which represents a range of business, environmental, urban, and agri-

cultural interests. Maddock joined Boyle, which provides a wide range of engineering and architectural services in water supply, waste water treatment and reuse, and traffic and transportation, in 1957, and has served in his current capacity for more than 20 years. His leadership is largely responsible for Boyle's growth from four offices in California

to 20 offices nationwide, according to a company press release. Boyle is one of the nation's Top 100 design firms, according to *Engineering News-Record* magazine. Maddock's expertise in water resources earned him election into the National Academy of Engineering in 1993. Maddock received a BS degree in civil engineering from Virginia Polytechnic Institute



With a \$2 million grant from Bacardi Ltd., the Stockholm Water Foundation has established the Bacardi and Stockholm Water Foundation Professorship in the Department of Civil and Environmental Engineering. During a ceremony held in New York City in May, Manuel Jorge Cutillas, the president and CEO of Bacardi Ltd., said, "By endowing the MIT faculty chair, Bacardi Ltd.

resources and the teaching of water conservation and related techniques as they apply to a variety of international environmental problems. From left to right, Professor Rafael Bras, '72, ScD '75, the

head of the department;

Mark Wrighton, former provost; Arthur Goldstein, chair and CEO of Ionics, Inc.; Bo Krantz, the secretary general of the foundation; Professor Marten Landahl of the

Department of Aeronautics

& Astronautics; Manuel Cutillas; Jorge Rodriguez, VP for public relations at Bacardi; and President Charles Vest. Center: Professor Bras speaks with His Majesty King Carl XVI Gustaf of Sweden, who attended the ceremony.



DEGREE CODES

AE Aeronautical Engineer
BE Building Engineer
CE Civil Engineer
CHE Chemical Engineer
CSE Computer Science Engineer
DPH Doctor of Public Health
EAA Aeronautical & Astronautical Engineer
EE Electrical Engineer
EGD Doctor of Engineering

ENE Environmental Engineer
MAA Master in Architecture Advanced Studies
MAE Materials Engineer
MAR Master in Architecture
MCP Master in City Planning
ME Mechanical Engineer
MET Meteorologist
MIE Mineral Engineer
MME Marine Mechanical Engineer
MNG Master in Engineering

MPH Master in Public Health
MTE Metallurgical Engineer
NA Naval Architect
NE Naval Engineer
NUE Nuclear Engineer
OCE Ocean Engineer
PhD Doctor in Philosophy
ScD Doctor of Science
SE Sanitary Engineer
SM Master of Science

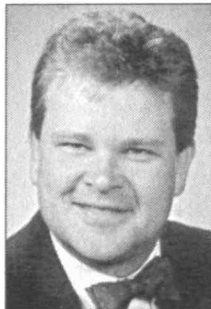
and an MBA from Stanford. He is a registered professional engineer in 18 states. His professional affiliations include the American Society of Civil Engineers (which recently named him an honorary member), American Consulting Engineers Council, Society of American Military Engineers, National Society of Professional Engineers, American Water Resources Association, and the American Water Works Association. He is also a member of the California Chamber of Commerce board of directors and has been appointed by the governor of California to the Western States Water Council.

The Association of Alumni and Alumnae was notified that **Howard Elwyn Webster, SM '37**, of Troy, N.Y., died on January 10, 1995. He was retired from the U.S. Air Force. No further information was provided.

Alumni/ae may send information for Course News to <mitalum@mitvmc.mit.edu>.

MECHANICAL ENGINEERING

Ernest B. Gardow, SM '58, professor and head of the Department of Mechanical Engineering at the University of Hartford in Connecticut, was named VP for professional practice of the American Society of Mechanical Engineers (ASME International). He is a former member of the Connecticut Board of Examiners for Professional Engineering. Gardow has been an active member of ASME International for more than 30 years and



R. Davis Webb, Jr.

served as a regional VP from 1980 to 1984. He holds a BME from Union College, and a PhD from the State University of New York/Buffalo. . . . **R. Davis Webb, Jr., SM '81, PhD '87**, was named the PAR (product application renewal) process manager in the bearings division of The Timken Co., an international manufacturer of highly engineered bearings and alloy steels that employs 16,000 people worldwide and had sales of more than \$1.9 million in 1994. Webb started at the Canton, Ohio-based company in 1982 as a process engineer. His previous positions at the company include principal development engineer, development specialist, and product-development specialist and manager. . . . From Boonton, N.J., **Peter Kalustian, SM '34**, writes: "I continue to be very active with my international consulting business in the field of processing fats, oils, and fatty derivatives. This area has been my principal professional interest for many years. I still enjoy downhill and recreational skiing. This past season, I skied 50 times locally as well as in Utah and Colorado. My ski club is the well known 70-Plus Ski Club. In my age group of 80-plus, I always manage to place first or very close to it in racing. My health continues to be very good. My daughter and her family live next door to me and she assists me in my practice as well as taking excellent care of me. My college-age



Joel M. Haynes, SM '93 (left), a PhD student in mechanical engineering at MIT, and **Alan H. Epstein, '70, SM '72, PhD '75** (center), professor of aeronautics & astronautics and associate director of the Gas Turbine Laboratory at the Institute, received the Gas Turbine Award of the American Society of Mechanical Engineers in June. They were recognized, along with **Gavin J. Hendricks** (right), a research engineer from United Technologies Research Center, for their paper, "Active Stabilization of Rotating Stall in a Three-Stage Axial Compressor." Haynes' research at the Combustion Research Facility focuses on cutting-edge low-NOx burner technology. Epstein's research interests include gas-turbine aerodynamics and heat transfer, active control of turbines, compressor aerodynamics, turbomachinery measurement techniques, and micro-gas-turbine engines. Epstein's teaching, both at the graduate and undergraduate levels, has focused on aircraft and space propulsion.

grandson and granddaughter are excellent downhill skiers and I really enjoy skiing with them." . . . **Mark A. Kleidon, SM '84**, writes: "I am the information technology manager at Silicon Graphics Computer Systems. I can be reached via e-mail at <mkleidon@sgi.com>."

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MATERIALS SCIENCE AND ENGINEERING



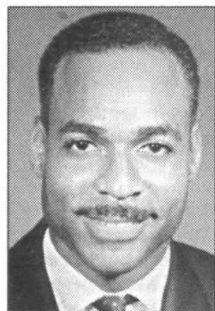
Susan Schur

Susan E. Schur, '60, SM '60, was elected a Fellow of the Society of Women Engineers and was installed in SWE's College of Fellows at the Society's national convention in June. Schur is the president of a firm that bears her name and provides technical communications services. She is also the president of The Technology Organization, Inc., and the publisher/editor of *Technology & Conservation* magazine. . . . **Thomas O. Mason, PhD '77**, reports: "I am the VP for member services at the American Ceramic Society. I am also updating the *Encyclopedia Britannica's* entry for industrial ceramics." . . . From Cupertino, Calif., **M. Carl Shine III, SM '61, MTE '62**, writes: "I am fortunate to have the support of Digital Equipment Corp., Universal Instruments, and Jet Spray Process Corp. of New Haven, Conn., in building a prototype of my invention, the Superplastic Connector Module, for direct chip attach applications. I hope to have results by the end of the fall to see if the module gives the high reliability predicted by the empirical model." . . . **H.J. Nusbaum, PhD '77**, reports: "My residency is finally over. I will join a private practice in obstetrics and gynecology in New Haven, Conn." . . . **Michael E. Pregarman, SM '84**, was named the general manager of manufacturing strategy for the bearings division of The Timken Co., a leading international manufacturer of highly engineered bearings and alloy steels based in Canton, Ohio. The company employs 16,000 people worldwide and had sales of more than \$1.9 million in 1994. Pregarman started his career at Timken in 1977 as a metallurgical trainee. His previous positions included metallurgist, process metallurgical engineer, manager of forming and heat treat, and green and forming. In 1992, he was named general manager of roller and cage manufacturing. He received a BS in metallurgy from Rensselaer Polytechnic Institute and an MBA from Walsh University.

Alumni/ae may send information for Course News to <mitalum@mitvmc.mit.edu>.

IV ARCHITECTURE

Ernest Kirwan, MAR '59, is a partner in the architecture and engineering firm of Keyes Associates. His recent projects included Polaroid Corp., WGBH/Channel 2 of Boston, NYNEX, Textron, and schools for Belmont, Taunton, Mansfield, and Waltham, Mass., as well as Hudson and Salem, N.H. . . . Via e-mail, Avik Roy, SM '88, writes: "I completed an MBA from the Wharton School at the University of Pennsylvania. After working as an urban design project manager for four years in Boston, it was quite a significant change to get back into academics as well as to move away from Boston. I joined McKinsey & Co., a



Michael Sherman

management consulting firm, at their New Jersey office. Having made a significant career change, I would welcome inquiries from other Course IV alumni/ae and students considering the same." Roy can be reached at <astana@aol.com>. ... **Michael Sherman, SM '93, MCP '93**, a planner/architect at Sasaki Associates, Inc., in Watertown, Mass., was recently certified by the American Institute of Certified Planners (AICP). The AICP is the professional arm of the American Planning Association, which certifies practicing city, regional, urban, and rural planners, and promotes continuing education and professional development. Sherman's projects at Sasaki Associates have included the LTV South Side Steel Works Master Development Plan in Pittsburgh, Pa., the Charleston Naval Complex Reuse Plan in North Charleston, S.C., and the Albany State College Master Plan in Albany, Ga. Prior to joining Sasaki Associates in 1993, Sherman was a planner with the City of Newton, Mass., and with the National Capital Planning Commission in Washington, D.C., where he provided urban design studies and geographic information systems services. He also worked for the Livas Design Group in Norfolk, Va., and served for four years in the U.S. Army Corps of Engineers. He earned a BA from Hampton University in 1986. . . . From Montreal, **Radoslav Zuk, MAR '60**, shares the following good news: "I was elected an honorary Fellow of the Ukrainian Academy of Architecture and was included (via entry and illustration) in the *History of Canadian Architecture* (Oxford University Press, 1994)." . . . *City of Bits* by **William J. Mitchell**, professor of architecture and media arts and sciences and dean of the School of Architecture and Planning at MIT, was recently published by the MIT Press. The book is described as "a comprehensive introduction to a new type of city, a largely invisible but increasingly important system of virtual spaces interconnected by the emerging information superhighway. William Mitchell makes extensive use of concrete, practical examples, and illustrations in a technically well-grounded yet accessible examination of architecture and urbanism in the

context of the digital telecommunications revolution, the ongoing miniaturization of electronics, the commodification of bits, and the growing domination of software over materialized form."

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V CHEMISTRY

Alexander M. Klivanov, an MIT professor of chemistry and a member of the Biotechnology Process Engineering Center, was elected to the National Academy of Sciences in recognition of his distinguished and continuing achievements in original research. His research interests include the stability and stabilization of proteins, enzymes as catalysts in organic chemistry, immobilized enzymes and cells, and enzymes in extreme environments. He has published more than 170 scientific papers, holds several patents, and is a member of six journal editorial boards. He has received numerous prestigious awards and was elected a member of the National Academy of Engineering and a founding Fellow of the American Institute for Medical and Biological Engineering. He received an MS in chemistry in 1971 and a PhD in chemical enzymology in 1974 from Moscow University. After immigrating to the United States in 1977, Klivanov spent two years as a postdoctoral associate in the chemistry department of UC/San Diego. In 1979, he joined the MIT faculty.

Michael C. Venuti, PhD '79, was promoted to the newly created position of VP for chemistry at Arris Pharmaceutical Corp. in San Francisco. Venuti will manage the four functions that represent Arris' core chemistry capabilities: medicinal chemistry, combinatorial chemistry, computational science, and structural biophysics. Venuti joined Arris in November 1994 as the director of medicinal chemistry. He is a co-founder of Parnassus Pharmaceuticals, a start-up biotech company where he served as VP and chief scientific officer. Between 1979 and 1994, he worked at Syntex and Genentech. Arris Pharmaceutical Corp. is engaged in the discovery and development of synthetic small-molecule therapeutics. The company uses structure-based drug design that integrates molecular biology, structural biophysics, and synthetic, combinatorial, medicinal, and computational chemistry capabilities to shorten the drug discovery and development cycle. Arris' research and initial product development programs are focused in two major areas: protease inhibitor-based therapeutics for multiple therapeutic applications; and oral cytokine and growth factor mimetics. . . . **Kevin J. Yarema, PhD '94**, a former graduate student of Professor John Essigman, received the Dissertation/Thesis Summary Award from the Drug Information Association. The award consists of a \$10,000 cash prize and a duplicate unrestricted gift to Essigman's lab. Yarema's graduate work suggested ways that the widely used anticancer drug cisplatin could be chemically altered to reduce its mutagenic and therefore potentially carcinogenic properties while retaining its chemotherapeutic effectiveness.

Robert Paul Eppe, PhD '47, of Rockville, Md., died on May 2, 1995. Eppe joined the

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Atomic Energy Commission (which eventually became the Department of Energy) in 1962. He helped develop and administer DOE research programs dealing with chemistry and nuclear materials. He retired from the department's nuclear, structural, and inorganic chemistry branch of its research division in 1981. Epple was a 1938 graduate of Juniata College in his native Pennsylvania. During WW II, he worked on the Manhattan Project to develop the atomic bomb. He served on the faculty of Brown University from 1946 to 1951. He then joined Tracerlab, Inc., a Massachusetts-based, private organization where he supervised studies on radioactive debris and atomic weapons. From 1956 to 1962, he worked on projects involving radiation chemistry for Arthur D. Little in Cambridge. He was a member of the American Chemical Society and Sigma Xi national science honor society.

Alumni may send information for Course News to <mitalum@mitvmc.mit.edu>.

VI ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

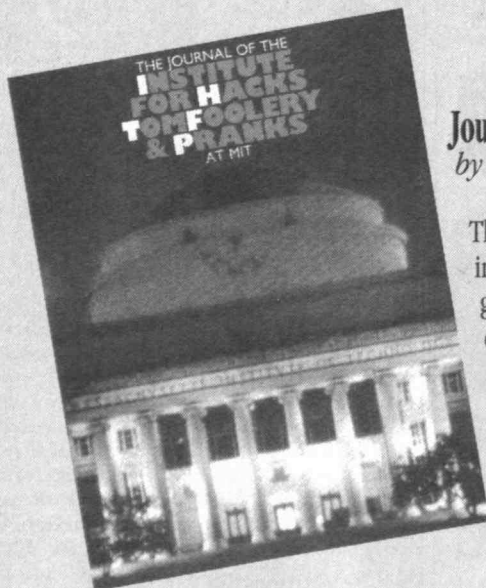
The following Course VI alumni were inducted into the National Academy of Engineering in September: **Arthur Baggeroer**, SM '65, EE '65, ScD '68, the Ford Professor of Engineering at MIT, for contributions in signal processing applied to sonar; **K. Mani Chandy**, PhD '69, a professor of computer science at the CalTech, for contributions to computer performance modeling, parallel discrete-event

simulation, and systematic development of concurrent programs; **Ralph L. Keeney**, SM '67, EE '68, PhD '69, a professor of systems management at the University of Southern California, for contributions to the theory and engineering practice of decision analysis as applied to complex public problems with conflicting objectives; **Jerome H. Milgram**, '61 (VI, XIII), SM '62 (XIII), PhD '65 (XIII), the William I. Koch Professor of Marine Technology at MIT, for the design of sailing vessels and solutions to such ocean engineering issues as environmental impact and towing dynamics; and **Bernard Widrow**, '51, SM '53, ScD '56, a professor of electrical engineering at Stanford University, for contributions to the theory of quantization noise, adaptive signal processing, and neural networks.

"In December 1994, I received the National Medal of Technology from President Bill Clinton," writes **Joel S. Engel**, SM '59, the VP for technology and CTO of Ameritech in Chicago. . . . **Stephen Jatras**, SM '52, was appointed by Oklahoma Governor Frank Keating to the state Regents for Higher Education in June. Jatras was chairman and president of Memorex Telex Corp. from 1988 to 1990. He earned a BS from Carnegie-Mellon University in 1947 and received an MBA from Stanford in 1958. He is active in numerous civic and professional organizations. "I'm delighted to name Stephen to the state higher education regents," Keating said. "He will do an excellent job in ensuring the best for Oklahoma's undergraduate and professional students. I'm excited for the other members of the higher education regents as well. They are gaining a most knowledgeable public servant." . . .

Jacob Ziv, ScD '62, a distinguished professor in the Department of Electrical Engineering at Technion-Israel Institute of Technology, was honored by the IEEE in June. Ziv received the IEEE Richard W. Hamming Medal for his contributions to information theory, and to the theory and practice of data compression. His research has covered general topics in data compression, information theory, and statistical communications. He pioneered several aspects of the theory of complex error-correcting codes, which was the precursor of concatenated coding, an important branch of modern error-correcting coding theory. He also contributed to the derivation of the fundamental Ziv-Zakai bound on performance of parameter estimators, a useful tool for communication engineers. In addition, his contributions to universal source coding led to the development of a complete and unique information theory for individual sequences in data compression. The Lempel-Ziv universal data-compression algorithm derived jointly with Abraham Lempel was adopted as a standard by the data communication industry. It is also the most commonly used data compression algorithm in the computer industry. Prior to his tenure at Technion, Ziv worked for the Scientific Department of the Israel Ministry of Defense. He also has held positions on the technical staff of Bell Laboratories in Murray Hill, N.J. Ziv earned a BS and MS in electrical engineering from Technion-IIT. He is an IEEE Fellow, a member of the Israel Academy of Science, and a Foreign Associate of the United States National Academy of Engineering. In 1993, he received the Israel Prize in Exact Sciences, and he is the recipient-elect of the 1995

Hack \hak\ *n* 1: A prank, usually elaborate. *v* 1: To perform a prank. 2: To explore the places on campus that are not usually accessible. 3: To work at or study a subject not especially for academic gain.



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The annual Cecil Green, '23, luncheon for Texas Instruments' VI-A program participants was held in July at the Petroleum Club in Dallas. Green, one of the founders of TI and an alumnus of VI-A, was unable to attend this year's luncheon. Seated with Professor Markus Zahn, '67, ScD '70, (third from the left), the director of the VI-A program, are students Brian Davison, John Wallberg, and Gregory Swize (from left to right).

Marconi Award. . . . Michael C. Loui, PhD '80, a professor of electrical and computer engineering at the University of Illinois/Urbana-Champaign, writes: "Although winning teaching awards at a research university is considered a cardinal sin, last spring I won the campus's Luckman Distinguished Undergraduate Teaching Award."

The Association of Alumni and Alumnae was notified that Richard Lundelius Best, SM '52, of Wayland, Mass., died on September 11, 1994. No further information was provided.

Alumni/ae may send information for *Course News* to <mitalum@mitvmc.mit.edu>.

VI-A INTERNSHIP PROGRAM

As you read this in the fall, we will have hopefully survived another unbearably hot and humid summer here in New England—as we fortunately did last year. It's becoming repetitive!

Professor Markus Zahn, '67, SM '68, EE '69, ScD '70, visited our southern, mid-western, and western VI-A company affiliates this past summer, thereby completing the survey started last year when he assumed the directorship of VI-A. As of the writing of this column (late July), the students' mid-term reports are coming in and providing a detailed look at how their work assignments are panning out.

I have just about completed setting up a new library in the department's Jackson Memorial Room. The library will include books written by VI-A faculty over the years and a section of other publications relating to MIT's history. If any of you have something you would like to add to this collection, please contact me.

I recently had an informative conversation with Professor Gordon S. Brown, '31, SM '34, ScD '38, whom many of you may remember as director of the Servomechanisms Laboratory, head of the Department of Electrical Engineering, and dean of Engineering. He is also the person who hired me as his assistant in 1956! Brown said the he and his wife, Jean, have a new address: Santa Catalina Villas, 75000 N. Calle Sin Envidia, Apt. 1204, Tuc-

son, AZ, 85718.

A recent visitor was Professor Denice D. Denton, '82, SM '82, EE '83, PhD '87, of the Department of Computing and Electrical Engineering at the University of Wisconsin/Madison. The National Science Foundation is establishing a new national Institute for Science Education, which is to be headed by Denton and Andrew Porter of the Wisconsin Center for Educational Research. The institute is expected to conduct and synthesize research on education in mathematics, engineering, science, and technology. Our congratulations to Denice!

I also spoke with Philip O. Martel, '71, SM '72, who is the chief engineer at SenTech, Inc., in Lexington, Mass. He and his wife, Marlene, live in Salem, N.H. I've also been in contact with Doran L. Morrison who worked with Martel during the latter's VI-A internship at Ordnance Systems in Pittsfield, Mass. and who, for many years, helped co-ordinate General Electric's participation in VI-A.

I'm also happy to report that Edward J. Ouellette III, '94, SM '94, recently passed his doctoral qualifying exam and will continue with his thesis work over the next several years. He is serving as a tutor at Next House while living on campus.

Of departmental administrative interest is the retirement of Professor Leonard A. Gould, '48, ScD '53, as the EECS undergraduate officer. Taking over that function this fall will be Professor William T. Peake, '51, SM '53, ScD '60. Following that, Dean Arthur C. Smith, who will be on leave for the 1995-96 academic year, will return to MIT as the EECS undergraduate officer.

The Association of Alumni and Alumnae was notified that Henry Clyde Johnson, '36, SM '36, of Bloomfield Hills, Mich., died on June 9, 1995. He had been retired as the chairman of Gar Woods Industries of Canada, Ltd. We send our condolences to his family.

I hope you all enjoyed a wonderful summer!—John A. Tucker, director (emeritus) and lecturer, VI-A Program, MIT, 77 Mass. Ave., Rm 38-473, Cambridge, MA 02139-4307; e-mail: <jat@fenchurch.mit.edu>.

CourseNews

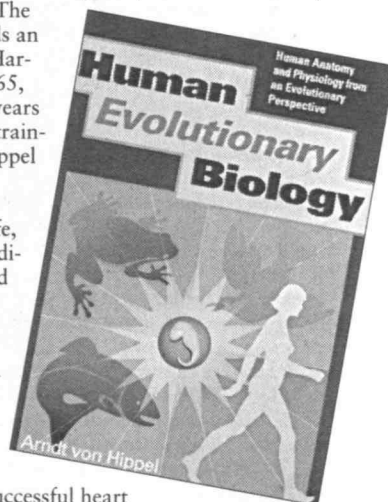
VII BIOLOGY

Human Evolutionary Biology: Human Anatomy and Physiology from an Evolutionary Perspective by Arndt von Hippel, '53, was published by Stone Age Press earlier this year. An excerpt from the back cover of the book describes the content as follows: "Everyone is interested in human biology. Anatomy and physiology permeate our daily experiences from conception until death. Biology holds the key to our love and hate, health and sickness, reproduction and infertility, terrible two's, and adolescent rebellion. Indeed the study of human biology opens the door toward an understanding of life itself. Despite many pieces still missing, the overall patterns are clear—nature is prolific, resources are limited, competition is fierce, variation is inevitable.

With only the most fit surviving to reproduce, natural selection brings about endless adaptive changes." The book, which costs \$29.95, may be ordered by calling (907) 279-3740 or (907) 278-1475. The author holds an MD from Harvard.

In 1965, after eight years of surgical training, von Hippel moved to Anchorage with his wife, who is a pediatrician, and their children. His broad and varied medical experience in Alaska included

starting a successful heart surgery program. Following retirement, von Hippel taught a popular course in human anatomy and physiology at the University of Alaska—that course gradually evolved into the book.



VIII PHYSICS

Thomas M. Cover, '60, the Kwoh-Ting Li Professor of Engineering at Stanford; Robert W. Deutsch, '48, the chairman and president of RWD Technologies, Inc., in Columbia, Md.; and Richard H. Lyon, PhD '55, a professor of mechanical engineering at MIT, were inducted into the National Academy of Engineering in September. Cover was cited for contributions to the theory and practice of pattern recognition, information theory, and communications. Deutsch was honored for founding companies to improve human performance in high-technology industries. Lyon

was recognized for the development of statistical energy analysis and machinery diagnostic techniques.

Alumni/ae may send information for Course News to <mitalum@mitvmc.mit.edu>.

X CHEMICAL ENGINEERING

Christian W. Knudsen, SM '65, ScD '69, reports: "In December 1994, Curbotek, the chemical company that I started in 1983, was chosen as one of *Chemical Week's* Hot Prospects (entrepreneurial, private, less than \$100 million in annual sales). Curbotek, which is located in Houston and has 15 employees, does chemical R&D and precommercial production for large, medium, and occasionally small chemical companies."

Arthur R. Winters, Jr., SM '52, reports: "I am still doing some consulting with CCI Cryogenics, Inc., in Allentown, Pa."

Lou Shrier, SM '60, reports: "I was the featured lecturer at the 10th Annual Festival of the Economics Institute of Peking (Beijing) University. My lecture was entitled 'The Global Petrochemicals Industry: A Business History.' I have made several trips to China to promote foreign investment in the energy and chemicals industries, and have also spoken at a business school and chemical engineering university in Beijing."

Richard D. Packard, SM '51, writes: "Last year, I enjoyed a safari to Africa that included the Serengeti Plain, Olduvai Gorge, a climb on Mt. Kilimanjaro, Tarangire National Park, Arusha, Tanzania, and Kenya."

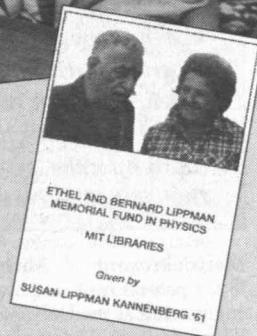
Jacek Jedruch, SM '58, of Summit, N.J., died on March 17, 1995. A scientist and nuclear engineer for Ebasco Services-Raytheon Engineers and Constructors in New York for many years, Jedruch helped design a nuclear engine for space application and the Tokamak Fusion Test Reactor at Princeton University. He produced a detailed accident analysis of the Heavy Water Reactor along with 60 technical articles and a book entitled *Nuclear Engineering, Databases, Standards, and Numerical Analysis*. Jedruch had a lifelong interest in history and wrote *Constitutions, Elections, and Legislatures of Poland* in 1982. The popularity of that book led to his membership in the International Commission for the History of Parliamentary and Representative Institutions. Jedruch last served as the group's treasurer. In 1990, he translated "Constitutions, Elections, and Legislatures of Poland" into Polish for Bicentennial Publications of New York. A thousand copies of the book were presented to the newly elected first post-communist parliament of Poland. A member of the American Nuclear Society and the American Society of Mechanical Engineers, he also belonged to the Polish Institute of Arts and Sciences, the Pilsudski Foundation, and the Kosciuszko Foundation. Born in Warsaw, Jedruch served as a member of that country's army. He escaped from his homeland in 1946 and lived in London before immigrating to the United States in 1950.

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FIRST BOOK FUND IN PHYSICS—

Susan Kannenberg, '61, was joined by her husband, Lloyd, also Class of '61, and her daughter, Susanna, when she met with MIT Director of Libraries Jay Lucker (far right) last spring to officially acknowledge the establishment of MIT's first book fund in physics. Both of the Kannenbergs earned their degrees in Course VIII. Susan Kannenberg set up the \$10,000 fund to honor the memory of her parents, Ethel and Bernard Lippman, and their abiding interest in education. Inset: the bookplate for books purchased through the new fund. (Jay Lucker retired in August after 20 years as director of the MIT Libraries.)



X-A PRACTICE SCHOOL

Practice School alumnae who finished doctorates during the 1995 summer session included Erin Malley Johnson, SM '92, PhD '95, and Chia-Li Liu, SM '95, PhD '95. Liu, who worked at the Albany (GE) and Midland (Dow) stations as a SCEP student, wrote a thesis entitled "Partitioning of Biomolecules in Two-Phase Aqueous Micellar Systems." For Johnson, whose SCEP work was at Midland and West Point (Merck), finishing her thesis, "Partitioning and Diffusion of Macromolecules in Gels," was the least of it; just one month after she defended her thesis, she and Mark Johnson, SM '92, became parents on August 8 of Katherine Nicole, who weighed in at 6 lbs. 14 oz. and has brownish-red hair.

Anita Parkinson, SM '94, who was back in Cambridge for the wedding of her classmate Nancy J. Zoeller, SM '94 (X), last summer, told Carol Phillips in the SCEP office of her new job: Parkinson is doing process modelling at Noram Engineering Co. in Vancouver, B.C. . . . From engineering processes to engineering sheet music: by e-mail to the SCEP office, Richard Wuopio, SM '60, reports that he has retired after a 35-year career in process engineering at Chevron in Richmond, Calif. He's now busy with the challenge of expanding his Solid Brass Music Co., a sheet-music publishing enterprise run (so far, at least) out of Wuopio's home in San Rafael. He can be reached at <slldbrass@aol.com>.

Frederick C. Eaton, SM '31, of Peoria, Ill., died on April 4, 1995. Eaton spent almost his entire professional career with the Lego Oil & Transport Co., the Esso/Exxon affiliate in Aruba, Netherlands West Indies; he was at various times listed as chemist, senior engineer, and supervisor of the chemistry laboratory prior to his retirement in 1967. Thereafter, Eaton made his home in Winter Haven, Fla., until the early 1990s.

Send word of your activities to any of the following: Carol Phillips in the SCEP office, MIT, Room 66-309, 77 Massachusetts Avenue, MIT, Cambridge, MA 02139, <carol@pracschool.mit.edu>; Stephanie Grepo at *Technology Review* <grepo@mit.edu>; or the undersigned at *Technology Review*, address as below, or fax (617) 258-7886.—John Mattill, Room W59-200, 77 Massachusetts Avenue, MIT, Cambridge, MA 02139.

XI URBAN STUDIES AND PLANNING

President Clinton appointed Julia C. Vindasius, MCP '86, a 1995-96 White House Fellow. Vindasius, of Pine Bluffs, Ark., is executive director of the Good Faith Fund, the first peer-group lending program in the United States and the first in this nation modeled after a Third World organization, the Grameen Bank of Bangladesh. The non-partisan award is based on academic, professional, and civic

achievement, and this year's fellows include nine men and five women from across the country, all working to make a difference in their communities. The White House Fellows program places exceptionally talented men and women in full-time paid positions for a



Julia Vindasius

year at the White House and Cabinet-level agencies. White House Fellows write speeches, chair meetings, draft legislation, and coordinate policy. They also attend an education program of regular meetings with senior government officials, top business executives, journalists and other leaders. Vindasius earned a BA

from the University of California/Berkeley in 1983. In Arkansas, she sits on the boards of the Community Resource Group in Springdale, Pine Bluff Downtown Development, and the Arkansas Institute.

Mark P. Cullinan, MCP '83, writes: "I am the chief engineer at the Department of Environmental Management for the Commonwealth of Massachusetts."

Michael Sherman, SM '93 (IV), MCP '93, a planner/architect at Sasaki Associates, Inc., in Watertown, Mass., was recently certified by the American Institute of Certified Planners (AICP). The AICP is the professional arm of the American Planning Association, which certifies practicing city, regional, urban, and rural planners, and promotes continuing education and professional development. Sherman's projects at Sasaki Associates have included the LTV South Side Steel Works Master Development Plan in Pittsburgh, Pa., the Charleston Naval Complex Reuse Plan in North Charleston, S.C., and the Albany State College Master Plan in Albany, Ga. Prior to joining Sasaki Associates in 1993, Sherman was a planner with the City of Newton, Mass., and with the National Capital Planning Commission in Washington, D.C., where he provided urban design studies and geographic information systems services. He also worked for the Livas Design Group in Norfolk, Va., and served for four years in the U.S. Army Corps of Engineers. He earned a BA from Hampton University in 1986.

City of Bits by **William J. Mitchell**, professor of architecture and media arts & sciences and dean of the School of Architecture and Planning at MIT, was recently published by the MIT Press. The book is described as "a comprehensive introduction to a new type of city, a largely invisible but increasingly important system of virtual spaces interconnected by the emerging information superhighway. William Mitchell makes extensive use of concrete, practical examples and illustrations in a technically well-grounded yet accessible examination of architecture and urbanism in the context of the digital telecommunications revolution, the ongoing miniaturization of electronics, the commodification of bits, and the growing domination of software over materialized form."

Alumni may send information for Course News to <mtalum@mitvmc.mit.edu>.

1925-1995

GEORGE BEKEFI

A Much-Honored Plasma Physicist

Professor emeritus George Bekefi, a physics researcher and faculty member at the Institute for 38 years, died August 17 from leukemia at his home in Brookline, Mass. He was 70 and had retired from the MIT faculty this past summer.

Bekefi was widely known for his contributions to the field of plasma physics, particularly in the production of extremely high-powered microwave generators. In 1976, he and a staff researcher, Thaddeus Orzechowski, PhD '75, developed a source of radiation that produced bursts of microwaves 50 times more powerful than the largest conventional microwave generators then in existence. More recently, he made contributions to the development of free-electron lasers, which are useful in a wide variety of areas including communications, bulk chemical processing, fusion, and cutting, drilling, and welding.

Bekefi also cared deeply about his role as a teacher. In an article he submitted this summer to the physics department's newsletter, he wrote that having revealed "to hundreds of undergraduates the mysteries of physics, and guiding some 50 graduates towards the SM and PhD degrees, I am retiring after 38 fun-drenched years. Throughout, it has been a most delightful experience."

Bekefi was born in 1925 in Prague. After the occupation of Czechoslovakia by Nazi Germany in 1939, he fled to England. He received a BS from University College in London in 1948. He then went to McGill University in

Montreal as a graduate student and instructor in physics. He received a PhD from McGill in 1952 and remained there, first as research associate and later as assistant professor, until 1957. He then joined the Plasma Physics Group in the Research Laboratory of

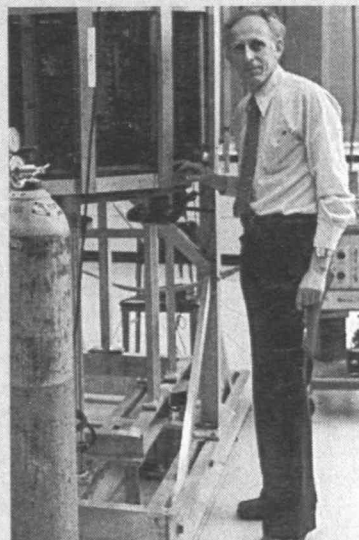
Electronics, with which he was affiliated throughout his MIT career. He joined the faculty of the Department of Physics in 1961 and was promoted to full professor in 1967.

In 1966, Bekefi was a visiting fellow at St. Catherine's College in Oxford, and, in 1972, worked at the University of Paris and at the Hebrew University in Jerusalem under a Guggenheim Fellowship. He was the author or co-author of three books and more

than 180 scientific papers and the recipient of seven patents. The books included *Radiation Processes in Plasmas* (1966) and with A.H. Barrett, an undergraduate text, *Electromagnetic Vibrations, Waves, and Radiation* (1977).

His honors included the 1995 Free-Electron Laser Award by the American Physical Society; the Gold Honorary Medal for Merits in the field of Physics Sciences from the Academy of Sciences of the Czech Republic in 1993; and the Institute of Electrical and Electronics Engineers' Plasma Science and Applications Prize in 1989. He was a Fellow of the American Physical Society and served as chairman of the Society's Division of Plasma Physics in 1978. □

—Stephanie V. Grepo



George Bekefi at work in MIT's Francis Bitter National Magnet Laboratory in 1977.

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TECHNOLOGY SPECIALISTS*
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John Van Amsterdam,
PhD '93

*NOT ADMITTED TO ANY BAR

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David L. Cavanaugh
Brett N. Dorny
Douglas C. Daskocil
Kristofer E. Elbing
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XII EARTH, ATMOSPHERIC AND PLANETARY SCIENCES

Robert Bowman, PhD '55, writes: "I left the aerospace industry in the late 1970s. In 1981, I completed an MBA at UCLA. Two years later, I founded a consulting firm specializing in business development for middle-market firms. In 1991, I was named CEO of a mid-size manufacturing firm, and in 1994 became CEO of Chromo Hearts, an emerging fashion company. My two daughters are in Maryland and Arizona. My wife and I have three grandsons. The eldest aspires to attending MIT. From 1992 to 1994, I was an MIT educational counselor."

Alumni/ae may send information for Course News to <mitalum@mitvmc.mit.edu>.

XIII OCEAN ENGINEERING

Jerome H. Milgram, '61 (VI, XIII), SM '62, PhD '65, the William I. Koch Professor of Marine Technology at MIT, was inducted into the National Academy of Engineering in September for the design of sailing vessels and solutions to such ocean engineering issues as environmental impact and towing dynamics. . . A. Paul Ames, SM '67, NE '67, writes: "I was elected president of the MIT Club of Washington on June 14, 1995." . . Navy Lieutenant Commander Thomas J. Woodford, SM '91, recently participated in a commemoration of the end of World War II as part of New York City's eighth annual Fleet Week celebration aboard the aircraft carrier USS *America*. Woodford was one of 5,000 Sailors and Marines aboard the aircraft carrier who participated. This year, six U.S. Navy ships, five Coast Guard vessels, and navy ships from Canada, Denmark, and Italy took part in the celebration. Woodford and fellow crew members began the week with a parade of ships by the Statue of Liberty. Following the visit to New York City, Woodford headed south for the final phase of a Composite Training Unit Exercise (COMPTUEX) in the western Atlantic Ocean and Caribbean Sea. COMPTUEX was a two-part multinational exercise which included 18 U.S. ships and the Dutch ship HMNLs *Karel Doorman*. During the exercise, USS *America*'s squadrons dropped training bombs and fired torpedos and missiles at targets during day and night operations. The exercise is part of a year-long training cycle designed to prepare the 1,047-foot-long aircraft carrier and its embarked air wing of 70 tactical aircraft for an upcoming six-month overseas deployment. After being at sea for more than 30 days during the first phase of COMPTUEX, Woodford visited the Caribbean island of St. Martin for three days of recreation and relaxation. He joined the Navy in May 1983.

Retired Navy Captain Robert Lloyd Evans, SM '37, of Strafford, N.H., died on May 28, 1995. From 1935 to 1957, Evans designed naval vessels that contributed substantially to the Allied military victory in WW II. He received a citation for his contributions to preliminary designs of landing craft and the Midway class of aircraft carriers. Evans was also

largely responsible for the further design and development of the Sumner class of destroyers and recent classes of cruisers. He also contributed preliminary designs for the first nuclear-powered submarine, the *Nautilus*, and for the first "blimp-shaped" experimental submarine, the *Albacore*, which served as the model for future nuclear-powered submarines. Evans was active in the New Hampshire Society of Professional Engineers and served for 12 years as president of its "Math Counts" program. He was a member of the Society of Naval Architects and the New Hampshire Audubon Society. His other interests included wine making, golf, and sailing. He established the annual Bow Lake Sailing Regatta in Strafford. He and his wife were both cited in 1988 by the town of Strafford as its honored citizens.

Alumni/ae may send information for Course News to <mitalum@mitvmc.mit.edu>.

XIV ECONOMICS

Investment in Women's Human Capital by T. Paul Schultz, PhD '66, was recently published by The University of Chicago Press. . . Keane, Inc., has appointed Winston R. Hindle Jr., SM '54, a former senior executive at the Digital Equipment Corp., to the company's board of directors. As a board member, Hindle will help Keane align operations and strategy for continued growth and development. Keane is a \$350 million software services company that designs, develops, and manages software for corporations and healthcare facilities. The company provides its services through its headquarters in Boston and through a network of more than 40 branch offices in major cities throughout the United States and Canada.

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XV MANAGEMENT

Beatrice Ballini, SM '86, writes: "I resigned from the Mergers & Acquisition Department at Goldman Sachs & Co. at the end of 1993 to join my sister, Barbara, at the family business in Italy. We are the fourth generation to lead one of the most prestigious shirt makers in Europe. Our growth is exponential. We are losing our minds managing it, but I have never had so much fun before." . . Samuel Appleton, Jr., SM '57, writes: "I have been the engineering manager at Eastern Acoustics Works since July 1993." . . "My wife, Lucy Fisher, and I are delighted to announce the birth of our son, Harry Fisher Garstka, on April 9," writes Michael T. Garstka, SM '94. "I am at Bain & Co.'s London office and have been involved in an interesting collection of strategy, marketing, re-engineering, and product development cases." . . From Cambridge, Mass., Gregory Hennessy, SM '93, writes: "I recently joined Gould-Kreutzer Associates where I'm involved in system dynamics and organizational learning consulting." . . J. Drew Ward, SM '86, writes: "Kirsten and I are proud to announce the birth of Alexander Ward, our second child, on January 9. His sis-

A WARTIME WONDER

THE U.S. CONSTRUCTION OF SHIPS

Even in this year of memorializing the Allied victory in World War II, Kurt Hasselbalch's turf has not been overrun with journalists and reminiscing veterans, but it should be. As curator of the Hart Nautical Collection of the MIT Museum, and its new "Ships for Victory" exhibit, Hasselbalch makes a very powerful case for the "superhuman" shipbuilding effort undertaken by the United States as a critical element in the war's outcome.

Shipbuilding had hit a low in this country by the early 1940s. Until well into 1942, the Axis nations were sinking ships faster than the Allies were building them, says Hasselbalch.

But in three short years, Americans were outbuilding any other country, with record-breaking numbers of naval and merchant ships launched annually. The war-time investment in ships totalled some \$42 billion—in 1945 dollars. (Just to put that number in perspective, the entire investment in the Radiation Laboratory was less than \$1 billion.)

"Had we not been able to produce the phenomenal number of ships to

move people and equipment overseas—well, you could imagine any number of scenarios," muses the curator.

Among those leading the construction charge, says Hasselbalch, were a number of MIT alumni, notably Vice-Admiral Edward L. Cochrane, '15, who as chief of the Bureau of Ships "was absolutely in control of all naval construction from the end of 1942 until the end of the war."

On the merchant marine side was Rear-Admiral Emory Land, '07, another graduate of Course XIII (then known as Naval Architecture and Marine Engineering). As soon as he was named chair of the U.S. Maritime Commission in 1942, Land launched an ambitious program of building 50 new boats a year, a goal that mushroomed to 200, then 500, and finally to 1,000 boats a year. In the end, Land oversaw the building of 2,700 Liberty merchant ships to serve the war effort.

"No one would have conceived that number as even a possibility," Hasselbalch says. "It required a remarkable juggling of politics, technology, and business savvy."

Assisting Land as the head of the technical division of the Maritime Commission was Admiral Howard Vickery, '21, once described as his superior's "Siamese

twin" because the two worked so well together.

In addition to leadership at the top, a cast of hundreds of Course XIII graduates staffed the shipyards that were revived or created for the war. The Maritime Commission and the Navy worked together to build more powerful engines and faster ships, work that was supported by MIT naval architects and marine engineers on campus.

Long hours and high stress in the workplace took their toll, at least on one overachiever, Hasselbalch notes. Admiral Vickery died of a heart attack late in the war after helping to break all-time shipbuilding records.

The "Ships for Victory" exhibit, which was assembled with support from Navy veteran John Lednický, '44, and the ocean engineering department, will probably have a two-year run in MIT's Hart Nautical Museum, open 9 a.m. to 8 p.m. seven days a week. □ —Lisa Watts



Edward Cochrane



Emory Land



Submarines under construction at the Bethlehem Steel Fore River shipyard in Quincy, Mass. Photo from the Hart Nautical Collections of the MIT Museum.

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WAR SHIPPING ADMINISTRATION

ter, Jenny, is now four years old. I am currently a coach for financial accounting and reporting for AT&T Global Information Solution's \$3.5 billion sales and services organization. I would welcome any calls or e-mail! My e-mail address is <drewward@aol.com> . . . **Susana Eddy**, SM '91, is an analyst with Citicorp Securities, Inc., in NYC . . . **Ricardo C. Vasi**, SM '91, writes: "After a three-year assignment in Mexico, we're back in St. Louis. On Thanksgiving Day 1994, we were very happy to welcome our second child, Alessandra. She's a healthy and beautiful baby girl. Francesco, our oldest child, will be four years old soon, though he looks like a big boy to us! I'm starting a new assignment at Monsanto in corporate planning as strategic planning director. I will define a strategy for the SBUs and the company. My wife, Ursula, and I welcome you whenever you're in the area." . . . **Maria Sakamoto-Vogel**, SM '94, an account officer with Citicorp, writes: "I was married on July 3, 1994, in Washington, D.C., and immediately after started work. I am living in Chicago and miss the Sloan "bar" reunions in Boston. Am I the only Sloan student from my class to relocate to Chicago? I would love to hear from anyone passing through the city." . . . **Sergio V. Menezes**, SM '92, reports: "Booz Allen & Hamilton promoted me to senior associate. I am at the São Paulo, Brazil, office and am involved in operations practice." . . . Also from São Paulo, **Gustavo A. Pierini**, SM '87, writes: "I left my position of partner at McKinsey & Co. to become head of M&A at Banco Pactual, the leading investment bank in Brazil." . . . **Jeremii W. Wesolowski**, SM '64, writes: "I joined Vestar in January 1993 after 10 years at Smith Kline Beecham. Vestar merged in February 1995 with Nexagen, a biotechnology firm. I am enjoying California life with my wife, Alice, and our two daughters, Andrea (10) and Ashleigh (6)." . . . From Chestnut Hill, Mass., **Larson Gunness**, SM '93, writes: "I was recently promoted to manager of new business operations at General Cinema Co. I am responsible for implementing and growing new entertainment ventures related to the company's existing operations. It's a great company in a fun industry." . . . **David J. Rubin**, SM '73, writes: "I left my private business after I was nominated by the government of Israel to be the economic minister for North America." . . . **Darren Walsh**, SM '84, is the branch manager of Kenan System's Denver office and program manager for all domestic telecommunications projects. . . . **Diane Mackie**, SM '79, writes: "I am still residing in London and welcoming classmates. **Mary Young**, SM '79, and I traveled 1,400 miles around France in August from Normandy to Provence." . . . **Jeff Norkus**, SM '80, reports: "I am working at IBM in the microelectronics division where I am focused on the development of a new product portfolio management system for memory and microprocessor and logic products." . . . **Joel Cutcher-Gershenfeld**, PhD '88, writes: "This summer I was promoted to associate professor with tenure in the School of Labor and Industrial Relations at Michigan State University. Also, I joined Richard Walton and Professor Robert McKersie, deputy dean of Sloan, as authors of *Strategic Negotiations: A Theory of Change in Labor Management Relations* (Harvard Business School Press, 1994). Finally, my family and I look forward to a 1995-96 sabbatical in

Boston." . . . **Timothy P. Loucks**, SM '90, is the director of quality for the Case Corp. in Racine, Wisc. . . . **Lance B. Roulic**, SM '88, writes: "In October 1994, I returned from Moscow, where I had lived for three years. This October, I moved to Malaysia with my family where I work as ASEAN Region Manager for Polaroid. We had our second child in August." . . . **Shinsuke Koga**, SM '80, writes: "Investment banking business is slow in Japan, particularly equity financing, M&A, and real estate. I am currently trying to securitize Japanese real estate, which has never been done before." . . . **Peter B.S. Ellis**, SM '82, was named VP for strategic planning at Textron. Ellis previously was the managing director of telecommunications practice and a member of the operating management committee of Arthur D. Little, Inc. His prior experience included VP for business development at ConTel Corp., a diversified telecommunications firm, and the senior planning executive for Merck & Co., Inc., the pharmaceutical company. Ellis received a BS degree in business management from Brigham Young University. . . . **Takako Ebata (Fujita)**, SM '92, writes: "We had a baby boy, Hiroshi, on December 1. I returned to my job as an associate at McKinsey & Company in April after my maternity leave ended." . . . **Shivan S. Subramaniam**, SM

'78, was named chairman of the board of Allendale Mutual Insurance Co. and its subsidiaries. He remains president and CEO. He joined the company in 1974, was elected senior VP and CFO in 1983, and in 1991 was promoted to executive VP. He assumed his current responsibilities as president in 1992 and the added responsibilities of CEO in 1993. Subramaniam is a 1970 graduate of the Birla Institute of Technology, where he earned a BE in mechanical engineering. In 1972, he was awarded an MS in operations research from the Polytechnic Institute of New York. Subramaniam currently sits on the board of directors for Allendale and FM Insurance Company, Ltd. . . . **Charles Tillet**, SM '91, is VP for finance and administration at Frontier Software in Tewksbury, Mass. . . . **Filippo de Nicolais**, SM '93, writes: "On March 6, 1995, I was appointed a manager of Schroders' corporate finance department. I am a team leader both for origination and execution purposes in M&A and capital markets deals. In the last two years, work has been very hard, but enjoyable. I have worked on a number of interesting projects. The largest has been the privatization of INA, the leading Italian life insurance company. The transaction was valued at \$3 billion, the largest equity offer to date in Italy. Schroders was the advisor to the



Three MIT students—the most in recent years—were awarded Marshall scholarships to study in Great Britain. Danielle Goodman, '95 (XVIII) (left), plans to earn a master's degree in public health at the University of Edinburgh in Scotland before attending medical school. Lik Mui (right), a first-year student in the Harvard/MIT Health Sciences and Technology program, intends to earn a master's degree in the engineering, economics, and management program at Oxford University, then return to the HST program to complete a PhD and an MD. Jeffrey Tomasi, '95 (VIII) (not pictured), plans to study at Cambridge University in preparation for an academic career in high-energy physics.

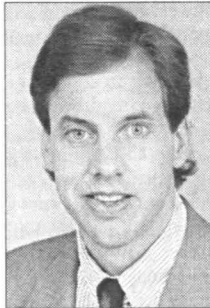
Italian Ministry of Treasury. You may be interested to know that the MIT presence at Schroders was reinforced with the hiring of **Henri-Pierre Jeancard**, SM '93, who used to attend a lot of courses at Sloan and dressed like a bum (just like me!). He is currently in Paris working in corporate finance." . . . **Richard L. Carrion**, SM '77, is the president of BanPonce Corp., which is one of the nation's leading Small Business Administration (SBA) loan makers. The company's Banco Popular, Puerto Rico's largest bank, has recently opened half a dozen branches in New Jersey. . . . **Matthew D. Breitenberg**, SM '77, writes: "I am pleased to announce the launching of Straight Path Management, Inc., a consulting firm in Princeton Junction, N.J., specializing in marketing and strategic planning. Straight Path is off to a running start with several challenging projects. Our motivation is seeing our clients achieve profitable growth by assisting them with creative and comprehensive solutions to their marketing and strategic challenges. I am excited about this new endeavor, as it brings to clients nearly 20 years of successful experience in corporate management and management consulting." . . . **Tom Monroe**, SM '94, has finally gotten settled into his new job at Roche in Basel, Switzerland, after the Syntex takeover. He welcomes e-mail correspondence at <tom.monroe@roche.com> . . . **Shin Hyun-soo**, SM '83, was promoted from VP to president of Pepsi-Cola Korea. Shin started his career as a research fellow at the Korea International Economics Institute. His other positions include national sales manager of Hyundai Electronics America and marketing director of Hyundai Electronics Industries in Seoul.

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SLOAN FELLOWS

Debra M.A. Rogers, SM '89, writes: "My company business, Entovation International, services leading clients including MIT, Columbia University, several research consortia, Big 6 accounting firms, and nations in transition (e.g., Poland, P.R.C., and Scandinavia). My article, "Virtual Learning: 5th Generation R&D," is scheduled for publication in *Research-Technology Management* in the fall of 1995." . . . **William J. Stolze**, SM '60, writes: "I recently wrote a book entitled *Start Up, An Entrepreneur's Guide to Launching and Managing a New Business*. Sales are approaching 50,000 copies. The text is being used in programs at more than 50 colleges and universities and is available through all major bookstore chains." . . . **Thomas M. Perdue**, SM '78, was named the assistant deputy undersecretary of the U.S. Department of Defense for ballistic missile defense. . . . **Peter Thomas McIntyre**, SM '93, is a resident manager of the Western Mining Corp. in Norseman, Western Australia. . . . **Michael Higginbottom**, SM '75, writes: "I completed my term as the headmaster of the Aldenham School in England. Now, I am a teacher-turned-gatekeeper working as a schools inspector." . . . **Phil Condit**, SM '75, president of the Boeing Co., was the subject of a full-page profile in *The Economist* (June 10). The profile lauded Condit for his informal, "walkabout" style, his management of the development and launch of Boeing's most recent aircraft, the

777, and his company-wide cost cutting program. "On the face of it," *The Economist* said, "Condit is the answer to Boeing's dreams: an engineer who can make good planes, a tough manager willing to declare war on costs, and a Boeing lifer who is not too proud to learn new tricks from a Japanese car maker [management techniques practiced at Toyota]." . . . **James C. Foster**, SM '85, the VP and general manager of Medtronic Heart Valves, Inc., was elected a member of the Life-Cell Corp.'s board of directors, an industry leader in the development and commercialization of universal tissue grafts and blood preservation products. Foster's prior positions at Medtronic include VP for cardiac surgery; VP/general manager for neuro-implantables; and VP for interventional vascular. Foster received a BS from St. Joseph's University. . . .



William Clay Ford, Jr.

William Clay Ford, Jr., SM '84, the chairman of the finance committee at Ford Motor Co., was promoted from treasurer to vice chairman of the Detroit Lions in February. Ford Jr. and his father William Clay Ford, who bought the Detroit Lions in 1964, share the same dream: to raise a Super Bowl championship flag beside the dusty 1957 NFL championship banner that hangs from the Silverdome's upper deck. Ford Jr., told the *Grand Rapids Press*: "I want the fans to plan their weekend around the Lions' game. I want the Lions to be the pride of everyone in the state of Michigan. I want the Lions to become the first team that youngsters are exposed to."

The Association of Alumni and Alumnae was notified that **Joseph Lawrence Lelli**, SM '61, of Bloomfield, Mich., died on May 20, 1994. He was retired from the General Motors Corp. No further information was provided.

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SENIOR EXECUTIVES

From the United Kingdom, **Harry Read**, '92, writes: "Since retiring from Nat West in the Spring of 1994, I have been operating as an independent consultant on IT strategy and implementation. I am now moving to Jersey, in the Channel Islands, to enjoy sea views, low taxation, and less stress!" . . . Captain **George Galdorisi**, '91, recently completed his tour in command of Amphibious Squadron Seven, the Navy's newest tactical amphibious squadron. He is currently the chief of staff for Cruiser-Destroyer Group Three, homeported in San Diego and embarked in the USS *Carl Vinson*. . . . **Sheldon Horing**, '86, was elected to the board of directors of Telco Systems, Inc. Most recently, Horing held the position of executive VP of Cincinnati Bell, Inc., and president and CEO at Cincinnati Bell Information Systems. From 1957 to 1990, Horing held a number of senior management positions at AT&T Bell Labs, including executive director of the data communications and business operations division and executive direc-

CourseNews

tor of transmission systems engineering. Horing received his doctorate in electrical engineering from Polytechnic Institute of Brooklyn and holds a master's degree in electrical engineering from New York University. Telco Systems designs, manufactures, and markets fiber optic transmission products, customer premise network access equipment, and inter-networking products. Primary customers include the Bell Operating Companies, independent telephone companies, interexchange carriers, and private network end users. . . . **Gary L. Cavey**, '94, has been appointed president and COO of Valmont Industries, Inc.'s industrial and construction products division. Cavey has been president of the division's North American operations for the past year. Before that, he was VP for marketing and sales for the division for nine years. Cavey joined Valmont in 1981. He is a graduate of the University of Nebraska.

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MANAGEMENT OF TECHNOLOGY

Francis Yeoh, SM '93, attended the MIT-NTU seminar in Singapore. Seminar speakers included President Charles Vest; Thomas Kochan, the George Maverick Bunker Professor of Management; Bob McKersie, the Society of Sloan Fellows Professor; and Professor Emeritus Ed Schein. Yeoh also visited with **Matt Tsien**, SM '93, who has transferred to the GM office in Beijing as the CTO. When Yeoh was in Boston this summer, he stopped by the MOT Program Office on his way to a meeting with the Media Lab at MIT. . . . While in Boston on vacation, **Josh Lindsay**, SM '93, stopped by the office with his daughter to say hello.

Chaur Ming Chou, SM '95, was hired by **Guy Hatch**, SM '94, in the newly created Management of Technology Team at United Technologies Research Center in Connecticut.—MOT Program, MIT, Room E52-126, Cambridge, MA 02139; e-mail: <mitmot@sloan.mit.edu>



AERONAUTICS
AND ASTRONAUTICS

Please see photo and caption on page MIT 42 for information on **Alan H. Epstein**, '70, SM '72, PhD '75. . . . **Arthur Wennerstrom**, SM '58, reports: "Last summer, I retired after 30 years of civilian service with the U.S. Air Force, where I conducted in-house R&D on fans and compressors for aircraft turbine engines. The last three years were spent as director of the NATO Advisory Group for Aerospace R&D (AGARD), in Paris. Last fall, I was made an honorary professor of the Beijing University of Aeronautics and Astronautics and the Institute of Engineering Thermophysics of the Chinese Academy of Sciences. I am now helping Duke University to develop some of its international interests in science and engineering." . . . **Janet M. Levine**, PhD '86, is producing and editing educational videos.

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XVIII MATHEMATICS

Richard P. Stanley and Daniel W. Stroock, professors of mathematics, were elected to the National Academy of Sciences. Stanley, who is also the chairman of the Applied Mathematics Committee, has been at MIT since 1970 (except from 1971 to 1973 when he was a research fellow at UC/Berkeley). In 1979, he became a full professor. He holds a BS from the CalTech and a PhD from Harvard University. Stanley is a member of the American Academy of Arts and Sciences, the American Mathematical Society, and the Mathematical Association of America. Among his numerous professional activities, Stanley is the AMS representative to the Committee on the American Mathematics Competitions (1991-97); a member of the advisory panel for the NSA Mathematical Sciences Program (1993-95); and the chairman of the program in combinatorics (1996-97) at the Mathematical Sciences Research Institute in Berkeley, Calif. Stroock, who holds a AB from Harvard College and the PhD from Rockefeller University, has been at MIT since 1984. He is an adjunct professor of the Beijing Normal University and has been a visiting professor at numerous universities including the University of Minnesota, the University of Louvain, the University of Paris, Kyoto R.I.M.S., and ETH/Zurich. He was a



Wendy Chan

Guggenheim Fellow in 1978-79. He is a member of the Institute for Mathematics and Applications and serves on the editorial board of the *Annals of Probability*. . . . Wendy Chan, PhD '95, joined the GE R&D Center as a mathematician. A native of Xiangtan, China, Chan earned a BS in applied mathematics in 1987

from Nanjing University and is a member of the American Mathematical Society. She and her husband, Tom, live in Niskayuna, N.Y.

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XXII NUCLEAR ENGINEERING

Maureen Psaila-Dombrowski, SM '86, PhD '90, was promoted to senior research engineer of corrosion at Babcock & Wilcox in Alliance, Ohio. She joined the company in 1991. She holds a BS in chemistry and physics from Wheaton College.

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TPP TECHNOLOGY AND POLICY PROGRAM

Stuart Batterman, SM '81, PhD '86, was promoted to associate professor (with tenure) of

environmental health sciences at the University of Michigan. He, his wife, Gloria Mason, and their 7-year-old son, Joel, are now permanent residents of the Midwest. His teaching and research activities include ambient and indoor air pollution, the regulatory and management aspects of hazardous wastes, contaminants in unsaturated soils, environmental impact assessment, biological exposure indices, and methods development for hard-to-measure organic contaminants. Other areas of interest include optimization, systems analysis, and environmental policy. He serves on the State of Michigan Hazardous Waste Board and is a technical adviser to several citizen groups on waste sites. To top this all off, he manages to bike to work—even through the occasionally harsh Midwest winters. . . . **Oswaldo Cortez**, SM '81, is focusing on Latin America as the international sales manager for Lube USA, Inc. He and his wife, Diana, have four children. . . . **Clinton Andrews**, SM '85, PhD '90, writes a quarterly column on technology and policy for the Institute of Electrical and Electronics Engineers. . . . **Lisa Prosser**, SM '92 (TPP & XV) and Walid Yassir married in New York on April 13, 1995. She left her job as a management consultant with the Wilkerson Group to enter a doctoral program in health policy at Harvard University. . . . **Alan Davidson**, '89 (XVIII), SM '93 graduated in May 1995 from Yale Law School and works for the Electronic Frontier Foundation in Washington, D.C. . . . **Jeff Goldman**, SM '94, reported that he spent the happiest and most fulfilling year of his life in South America. He visited Bolivia, Argentina, Brazil, Chile, Peru, Uruguay, and Paraguay. He plans to work in Asia and Africa. . . . **Marc-Antoine Saglio**, SM '95, is working for the French Ministry of Equipment. . . . **Ahmed Afifi**, who was a visiting scholar at TPP in 1990, is an assistant professor in the Department of Architecture at Helwan University and teaches urban planning & architectural design. He is also a visiting professor at the Flight Academy in Cairo and an engineering consultant for two small companies. He is married and has two daughters.—Richard de Neufville, TPP, MIT Room E40-252, Cambridge, MA 02139; e-mail: <tpp@mit.edu>

Deceased

The following deaths have been reported to the Alumni/ae Association since the *Review* last went to press:

Erwin Harsch, '20; June 30, 1995; Belmont, Mass.

Theodore Thomas Miller, '22; August 6, 1995; Lexington, Mass.

Harold Hudson Spengler, SM '23; May 29, 1995; Cleveland, Ohio

William Salem LaLonde, Jr., '23; May 27, 1995; Vero Beach, Fla.

Thomas Emerson Rounds, '23; April 6, 1994; Los Angeles, Calif.

Emanuel Tarplin, SM '25; November 22, 1988; E. Falmouth, Mass.

Ernest Clifford Van Blarcom, '26; June 1, 1995; Washington, D.C.

George Bapst Darling, '27; March 30, 1995; Hamden, Conn.

John Wesley Harris, '27; May 3, 1994; Millis, Mass.

Roland Deming Earle, '28; April 12, 1995; Plantation, Fla.

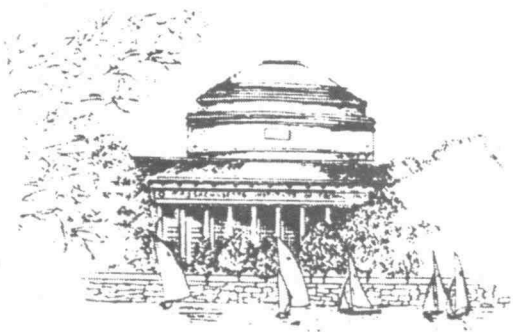
Kenneth Dwight Beardsley, '29, SM '30; March 25, 1995; Springfield, Mass.
William Jacob Knox, SM '29, PhD '35; July 9, 1995; W. Newton, Mass.
Jonathan Franklin McCray, '29; July 4, 1993; Bel Air, Md.
Bradford Weston Thompson, '29; December 13, 1994; Duxbury, Mass.
Edward George Giroux, '30; April 18, 1995; W. Baldwin, Maine
Robert D. Nutting, SM '30, ScD '33; March 3, 1992; Yorklyn, Del.
Thomas Henry O'Connor, '30; August 2, 1995; Milton, Mass.
Frederick Charles Eaton, SM '31; April 4, 1995; Peoria, Ill.
Clifton Austin Smith, '31; August 3, 1995; McLean, Va.
Charles Henry Behse, '32; February 27, 1995; Lakewood, Colo.
Herman Gustav Protze, '32, SM '33; May 12, 1995; Dover, Mass.
Leon Hyzen, '33, MAR '35; April 13, 1993; San Clemente, Calif.
Tucker MacDonald Vye, '33; July 16, 1995; York, Maine
Jesse Robinson Henshaw, '34; May 11, 1995
Kenneth Adelbert McCrimmon, '34; June 23, 1994; El Cerrito, Calif.
Arthur Roland Anderson, SM '35, ScD '38; June 23, 1995; Tacoma, Wash.
Utley Wilson Smith, '35; March 11, 1995; Devon, Pa.
Robert Miller Osborn, SM '36; May 16, 1995; Pasadena, Calif.
James Warburton, '37, SM '38; July 15, 1995; Alamo, Calif.
Abe Daitsh, SM '38; July 2, 1994; Sea Point, South Africa

Gifford Griffin, '38, SM '39; May 16, 1995; Moorestown, N.J.
Paul O'Connell, '38; June 6, 1995; Melrose, Mass.
Arthur James Cochran Wilson, PhD '38; July 1, 1995; Cambridge, England
Irving Finsen, '39; April 7, 1995; Wayland, Mass.
William Calvert Hollibaugh, '40; July 3, 1995; Newtown Square, Pa.
Robert Stewart Nelson, '40; October 22, 1994; Lafayette, Calif.
Francis Xavier Amsler, '41; October 15, 1994; W. Roxbury, Mass.
Ralph Benjamin De Lano, '41; July 23, 1995; Punta Gorda, Fla.
James Girdwood, '42; May 12, 1994; Englewood, Colo.
Carthrae Merrette Laffoon, '42; July 19, 1995; El Cajon, Calif.
Edwin Homer Stewart, '43; May 27, 1995; Los Altos, Calif.
Rupert Chorba Burtan, '44; May 22, 1995; Englewood, Colo.
Alexander William McEwan, '46; July 1, 1995; Lehigh Acres, Fla.
Jack Sargent, '46; April 12, 1995; Silver Spring, Md.
Benjamin Hogan Craig, '47; December 4, 1994; Florence, Ala.
Sheldon Irwin Kaplan, '48, '49; April 9, 1995
Calvin Northrup Mooers, SM '48; December 1, 1994; Cambridge, Mass.
Alan Edward Verner, '48; April 21, 1994; Lutherville, Md.
John Macarthur D. Walch, '48; July 6, 1995; Nutley, N.J.
William Henry Connolly, '49; July 10, 1995; Sudbury, Mass.

George Henry Ray, '49; January 20, 1995; Woburn, Mass.
James Cheever Farley, SM '50; April 14, 1995; Midlothian, Va.
Bradford Drew Pearson, '50; April 12, 1995; Surrey, B.C., Canada
Harold Aylesworth Spuhler, SM '50; March 24, 1995; Baytown, Texas
Ervin Edgar Underwood, SM '51, ScD '54; April 20, 1995; Big Canoe, Ga.
Robert Walter Ebeling, Jr., '53; SM '54; July 16, 1995; Reading, Pa.
William Bruce Kingkade, '53; May 18, 1995; Haverford, Pa.
Ernest Percival Abrahamson, '54, SM '55, ScD, '57; March 26, 1995; Chebeague Island, Maine
Donald Keith North, '54; February 9, 1995; Cambridge, Mass.
Alan Standish Dana, '55; June 2, 1995; Bryn Mawr, Pa.
William Kendall Talley, '55; January 8, 1993; Lexington, Mass.
Charles James Haase, '56; July 5, 1995
Edward Trivett Atkinson, '57; July 24, 1995; Cohasset, Mass.
Robert Homer Griffin, '61; May 19, 1995
Conrad H. Kollenberg, '62; December 4, 1993; Houston, Texas
John M. Chamberlin, '65; September 14, 1994; Pensacola, Fla.
Robert Douglas Blythe, SM '66; January 26, 1994; Atlanta, Ga.
Robert Edwin Wall, SM '72; June 22, 1995; Houston, Texas
Ronald Lee Main, '77; December 17, 1990; Vienna, Va.
Daniel Barlow Nelson, PhD '88; May 4, 1995; Chicago, Ill.



HERE MIGHT A NAME BEST LIVE?



The name of a deceased MIT alumna or alumnus can be linked to the Institute through gifts made by classmates, colleagues and family. Memorial gifts can be unrestricted or directed toward scholarships, research or any program of the Institute. The Institute notifies bereaved families of the name of each donor, and each gift becomes a part of MIT's permanent record.

Named endowed funds whose income supports the work of the Institute in perpetuity can be established with larger gifts. If you would like information on ways of expressing sympathy through a memorial contribution, or on establishing a named endowment fund, please contact Betsy Millard, MIT Room E38-202, Cambridge, MA 02139 or call (617) 253-8059.

PuzzleCorner

As I mentioned a few issues ago I attended a conference in Italy during June and before going, I listened to a few Italian tapes. For about two months, I probably averaged 15–20 minutes per day. I must say that the tapes worked and considerably enhanced my enjoyment during the trip. In fact I was disappointed when a group of us decided on a restaurant and the waiter spoke (excellent) English. I recommend the practice to everyone. The tapes I used were called “Listen and Learn Italian,” but I have no reason to believe they are better or worse than any others.

To repeat an announcement from last issue, we are still low on Bridge problems.

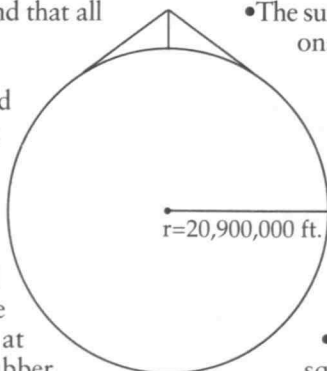
Problems

N/D 1. Here is an offering from Joseph Keilin, who writes:

On their way home from an evening of bridge, a couple was commiserating with each other. “Can you imagine that? We had 39 high-card points between the two of us, I played perfectly, and still we went down one at 3 no trump. And it wouldn’t have made a difference if you had been declarer,” said one. “The opponents played perfectly, also. Besides, it would have been even worse in any suit contract, again regardless of who was declarer,” said the other. What was the hand that all four players held?

N/D 2. Perhaps Richard Hess is considering some flagpole-sitting in cold climates. He writes:

Imagine a rubber band stretched around the world and over the North Pole as shown at right. Given that the rubber



band has had to stretch an extra foot to accommodate the North Pole, how high is the North Pole?

N/D 3. Warren Himmelberger just loves to have eight numbers add up to 260.

Write the numbers from 1 to 64 in the checkerboard square so that all columns and rows add up to 260, and also that the following groups of squares add up to 260:

+	○	+	/	\	+	○	+
○	+	/			\	+	○
+	/	□	*	*	□	\	+
/		*	□	□	*		\
\		*	□	□	*		/
—	\	□	*	*	□	/	—
○	—	/			\	—	○
—	○	—	/	\	—	○	—

- Any of the 70 arrangements of 2 by 4 squares.
- The sum of the 4 middle squares and 4 corner squares.
- The sum of any two adjacent half-diagonals (indicated by - - -).
- The sum of the interior half-diagonals (indicated by □).
- The sum of the top 3-square diagonals and the 2 corner squares enclosed (indicated by +), and the sum of the bottom 3-square diagonals and the 2 corner squares enclosed (indicated by -).
- The sum of the 4 2-square diagonals (indicated by ○).
- The sum of the pairs of squares adjacent to the 4 middle squares (indicated by *).
- The sum of the pairs of squares midway between the edge squares and those pairs adjacent to the 4 middle squares (the 8 blank squares).

Speed Department

Mike Auerbach has mechanized an old chestnut.

A condemned prisoner is placed in a cell with two unlocked doors and two computers. One door leads to freedom and the other to execution. Both computers know which door is which. One computer always tells the truth, the other always lies. The prisoner is allowed to ask only one question of either one of the computers. What should he ask?

Solutions

Jul 1. John Rudy wants to know how South is to make seven spades after West leads the diamond king.

	North	
	♠ A K Q J	
	♥ A x x	
	♦	
	♣ Q J 10 9 8 7	
West		East
♠		♠
♥		♥
♦		♦
♣		♣
	South	
	♠ 10 9 x x x	
	♥	
	♦ A x x x x x	
	♣ A K	

It does not seem possible to make the hand against all distributions. So Richard Thornton maximized the probability of success.

John Rudy’s bridge problem requires unblocking clubs in a way that gives the highest probability of success. Although most readers will arrive at the correct solution using intuition instead of calculation, readers of *Technology Review* should have no trouble with the calculation. Assuming that nothing about the distribution can be deduced from the bidding or other means (a peek?), the key is to remember that the numbers of combinations of m things taken n at a time is

$$C_n^m = \frac{m!}{(m-n)!n!}$$

One strategy is to allow for a 4-0 trump split but admit failure if East has no diamonds. To guard against the 4-0 trump split South takes the first trick with the diamond ace, throwing a club from North. Then dummy is entered twice with a trump and two small hearts are trumped by South (using the 10 and 9). On the fourth lead of trumps North unblocks clubs by throwing a high club from South and then throws the remaining club on the ace of hearts. This allows



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North to run four clubs for a win. This preferred strategy fails only if East has no diamonds, and the probability of such an event is

$$P = \frac{C_{13}^{18}}{C_{13}^{25}} = \frac{8568}{520030} = 0.0016$$

This calculation is based on the fact that the East hand has 13 of the 25 invisible cards and 18 of the 25 are not diamonds. Thus this strategy will fail only 0.16 percent of the time.

An alternate strategy is to trump the first trick and hope for a 3-1 or better trump split. In this case North has only enough trumps to lead them three times and South will have to lead the ace of clubs, before trumps are out, in order to unblock. This strategy will fail if the trumps are split 4-0, and after the initial lead the probability of such an event is computed as follows:

East has no trumps with probability

$$P_E = \frac{C_{13}^{21}}{C_{13}^{25}} = \frac{203490}{5200300} = 0.0391$$

West has no trumps with probability

$$P_W = \frac{C_{12}^{21}}{C_{12}^{25}} = \frac{293930}{5200300} = 0.0565$$

Since both East and West can not be void, the probability of one being void is $P_E + P_W$, so 9.56 percent of the time either East or West will be void in spades. The strategy will also fail if the clubs split 5-0 and the hand with no clubs has at least 2 trumps, an event that will occur about 4 percent of the time.

Conclusion: it is more than 100 times more likely for the second strategy to fail than for the first strategy to fail, but even the second strategy will work about 85 percent of the time. In this problem the probabilities are so different that it is intuitively obvious which strategy is most favorable, but in other cases the ability to calculate the best strategy is helpful, though not as helpful as a peek.

Jul 2. Chris Svenasgaard wants you to figure out who played whom and what the scores were in each game. Note that all games are intragroup and that (W, T, L, F, A, P) = (Wins, Ties, Losses, goals For, goals Against, 2W+T).

TEAM	GROUP A					
	W	T	L	F	A	P
Sampdoria	1	1	0	2	0	3
Panathinaikos	0	2	0	0	0	2
Red Star	1	0	1	3	4	2
Anderlecht	0	1	1	2	3	1

TEAM	GROUP B					
	W	T	L	F	A	P
Barcelona	1	1	0	3	2	3
Sparta Prague	1	0	1	4	4	2
Dynamo Kiev	1	0	1	2	2	2
Benfica	0	1	1	0	1	1

The following solution is from James Sinclair:

I refer to the teams by their names' first two

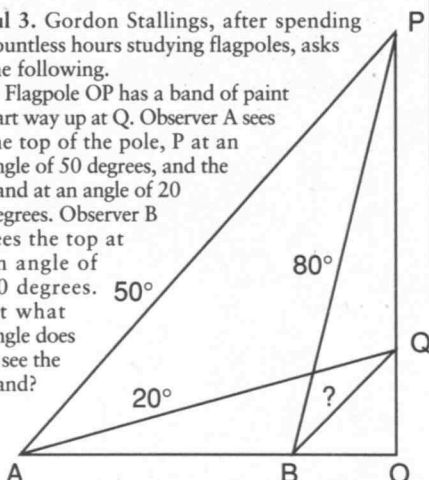
letters, to shorten things a bit.

GROUP A: Pa had 2 scoreless ties, which must have been with the only other tiers, Sa and An. Sa and Re had the only wins, and Re couldn't have beaten itself, so Sa beat Re (2-0, since Sa's tie was scoreless). Leaving: Re beat An, 3-2.

GROUP B: Ba and Be had a scoreless tie (since Be's total goals For = 0). So Ba's other game was a 3-2 win, which must have been against Sp because only Sp had more than 2 goals Against. So Sp's other game was a 2-1 win against the only remaining loser, Dy. Leaving: Dy beat Be 1-0.

Jul 3. Gordon Stallings, after spending countless hours studying flagpoles, asks the following.

Flagpole OP has a band of paint part way up at Q. Observer A sees the top of the pole, P at an angle of 50 degrees, and the band at an angle of 20 degrees. Observer B sees the top at an angle of 80 degrees. 50° At what angle does B see the band? 80° 20° ?



Many readers used trig tables to find that the angle is *about* 60 degrees; Harvey Amster shows us why it is 60 degrees:

Each observer can calculate the height of the pole in terms of his distance from its base and the angle that he sees to its top. Equate these expressions:

$OP = AO \tan 50^\circ = BO \tan 80^\circ$
Do the same for the spot on the pole:
 $OQ = AO \tan 20^\circ = BO \tan \theta$,
where θ is the angle to be determined. Thus,
 $\tan \theta = (AO/BO) \tan 20^\circ = (\tan 80^\circ / \tan 20^\circ) \tan 50^\circ$
Since $\tan \phi = 1 / \tan(90^\circ - \phi)$ for any angle ϕ ,
 $\tan \theta = (\tan 40^\circ) (\tan 20^\circ) / \tan 10^\circ$.
By using standard trigonometry tables, one can readily find that $\theta = 60^\circ$.

However, numerical tables do not show that this is the *exact* answer. For that, use is made here of the well-known multiple-angle formulas,
 $\tan 2A = 2t / (1 - t^2)$, $\tan 3A = (3 - t^2) / (1 - 3t^2)$,
 $\tan 4A = 4t(1 - t^2) / (1 - 6t^2 + t^4)$,
where $t = \tan A$. In our case, let $A = 10^\circ$ so that
 $\tan \theta = (\tan 4A) (\tan 2A) / \tan 8A = 8t / (1 - 6t^2 + t^4)$.
Although we don't have an exact value of t to put into this expression, we can find the exact value of the expression itself.

Equate the multiple-angle formula for $\tan 3A$ to $1/\sqrt{3}$, the well-known value of $\tan 30^\circ$. Then rearrange the resulting equation to
 $t^3 = \sqrt{3}t^2 + 3t - 1/\sqrt{3}$.

Multiply this equation by t , and then use this

same equation again for the t^3 in the resulting expression. The result is

$$1 - 6t^2 + t^4 = (8/\sqrt{3})t,$$

which is the denominator in the above expression for $\tan \theta$. Substituting it in gives the result: $\tan \theta = \sqrt{3}$. Therefore, $\theta = 60^\circ$ exactly.

Other Responders

Responses have also been received from H. Amster, E. Anderson, G. Blondin, M. Boas, Rev. M. Buote, W. Coffey, A. Cowen, W. Deane, F. Desimone, D. Edmonds, S. Feld, S. Feldman, E. Field, M. Fountain, J. Grossman, J. Harmse, W. Hartford, W. Hartford, C. Hess, L. Kells, J. Landau, M. Lindenberg, N. Markovitz, J. Maynard, D. Merkle, D. Merkle, B. Metcalfe, L. Nissim, L. Norman, A. Ornstein, R. Palacios, A. Palmer, D. Plass, J. Prussing, J. Prussing, C. Rappaport, K. Rosato, E. Sard, L. Schaider, A. Shagen, I. Shalom, T. Sim, N. Spencer, L. Steffens, H. Stern, F. Tydeman, F. Verhoorn, C. Wang, S. Wang, B. Wegerer, C. Whittle, J. Wright, B. Wurzbarger, and R. Yassen.

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Since 1958, he has founded six companies for the manufacture and distribution of industrial process instruments. One company has been recognized as the world leader in industrial Doppler ultrasonic flow measurement.

Mr. Dorflinger served as the president of the Houston section of the Instrument Society of America, and in 1988 was selected Entrepreneur of the Year in high technology manufacturing in the Southwest by the Entrepreneur of the Year Institute.

For MIT, Mr. Dorflinger served for many years on the Educational Council in Houston, was president of the MIT Club of South Texas, and has been active in all of MIT's major fundraising campaigns. As president of the Class of 1946, he is involved in planning its 50th Reunion.

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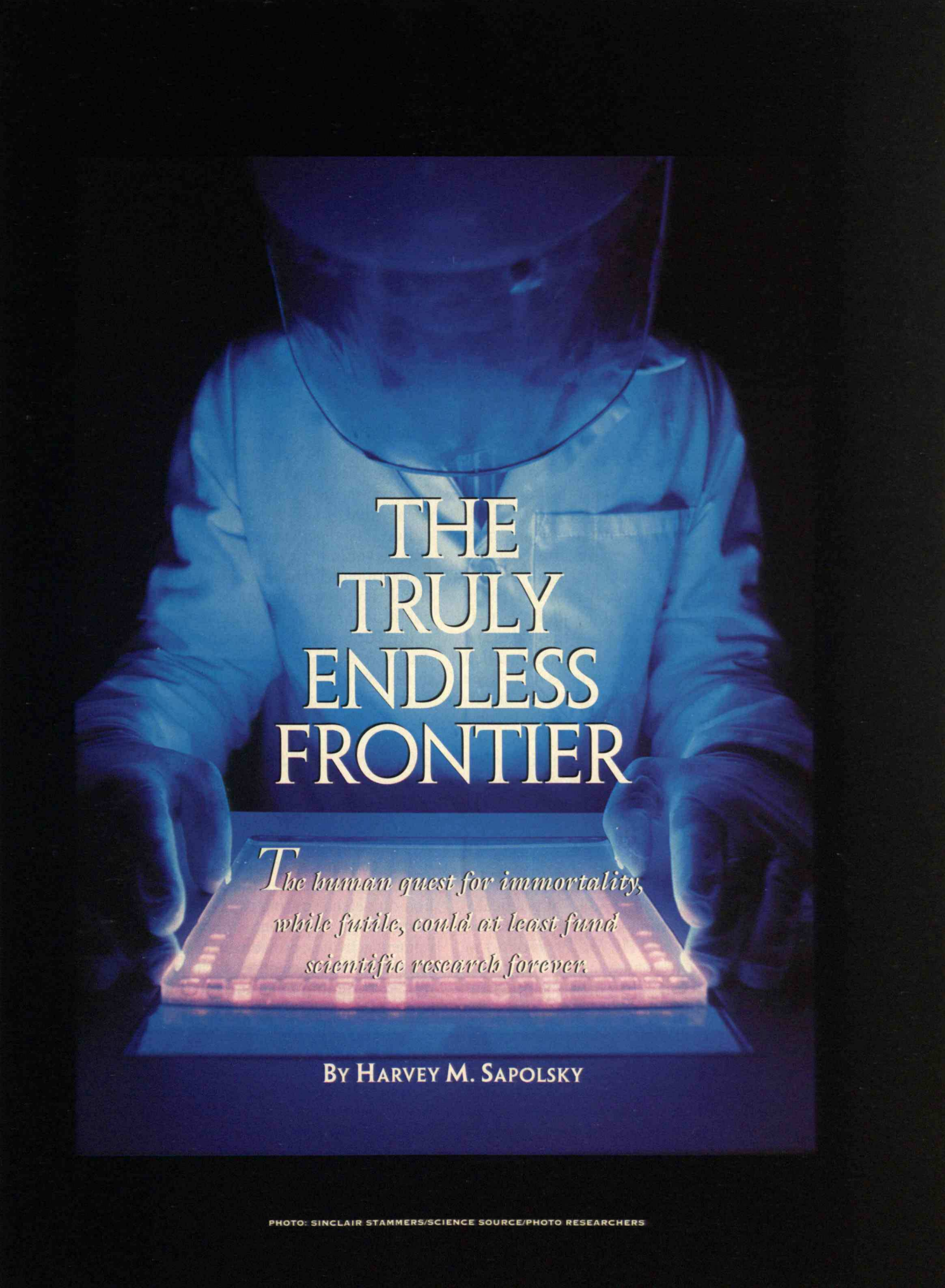
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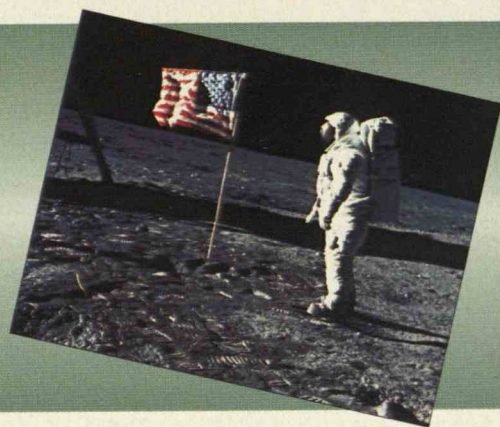
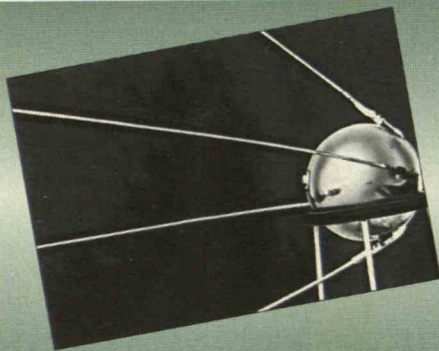


THE TRULY ENDLESS FRONTIER

*The human quest for immortality,
while futile, could at least fund
scientific research forever.*

BY HARVEY M. SAPOLSKY

THE COLLAPSE OF THE SOVIET UNION WAS A GREAT SHOCK TO ACADEMIC R&D.



The most devastating

weather that we experience is the hard-to-predict but inevitable storm that forecasters label a once-in-100-year event. In politics, though extreme events may appear more frequently, prediction is acknowledged to be even more difficult than in climatology. Thus it should not be surprising that few, if any, university administrators anticipated the double calamities that have recently befallen academic science—the end of the Cold War and the election of a Republican-controlled Congress, both of which were at least once-in-40-year events with powerful effects. In particular, they drastically reduced the basis of federal support for university-based research.

To thrive, academic science needs a persuasive political rationale. As wondrous as are the long-term promises of science, it needs a set of arguments that can relate research activities convincingly to governmental purposes so that taxpayers will be willing to provide the requisite billions of dollars.

Vannevar Bush, who led the mobilization of science during World War II, identified the range of politically convincing rationales for the support of science when he wrote his famous report *Science: The Endless Frontier* in 1945. Scientists at the time were anxious to return to the universities, but they also sought to retain the opportunities for large-scale and well-funded research that the wartime emergency had provided them. Bush argued that basic research, the kind best practiced at the universities, deserved substantial federal support because it not only furthered national security—the outcome of the war was ample testimony—but was also beneficial to the nation in other fundamental ways. It improved economic development, human health, and the quality of life, he maintained.

HARVEY M. SAPOLSKY is professor of public policy and organization and director of the Defense and Arms Control Studies program at MIT.

In devising specific plans for the organization of post-war science, however, Bush narrowed his focus to defense. For example, he included a division for national-security-related research in his outline of the agency that would become the National Science Foundation. He also was active in expanding the research and development programs of the newly formed Department of Defense. For Bush, science had to be closely linked to defense not only for the nation's sake but also for science's sake. As tensions built between the United States and Soviet Union, and as the military sought to exploit the technological advances achieved during World War II, no other rationale for the support of science appeared able to draw sufficient political backing.

The Good Old Days

Bush chose wisely (though his vision was not unique—with or without him, science could hardly have avoided being recruited once again for the defense of the nation). It was, one must admit, a very rewarding turn of events for science. The United States spent more than \$13 trillion on defense during the Cold War. Of those allocations, about 10 percent supported research and development activities, providing tens of billions of dollars for university-based scientists. Included in the largesse was money for equipment and facilities on a scale previously unimagined by academics.

The national-security rationale encompassed not only research support provided by the Department of Defense but also that offered by the Department of Energy (DOE), the National Aeronautics and Space Administration (NASA), and the National Science Foundation. The network of national laboratories supported by the DOE (originally the Atomic Energy Commission) and the department's physics research program were built on real and implied links to nuclear weapons, for example. Even the DOE's energy-related research was usually described as a national-security require-



ment, needed to hedge against interruptions to the supply of imported oil. And NASA was formed to demonstrate our technological prowess after the embarrassments caused by the Soviet Union's launching of the first space satellite. Anything that even remotely nurtured the ability to operate in space was deemed worthy of support.

Similarly, the National Science Foundation, although it was created without the national-security division that Bush had advocated, gained significant resources only when U.S. scientists in and out of government somewhat duplicitously claimed in the late 1950s that the country's space embarrassments were caused by inadequate support of basic research, although in fact they were the result of a conscious decision to focus rocket R&D on warhead-carrying ballistic missiles instead of spacecraft launchers. Scientists learned how to play the political game quite well during the Cold War.

The national-security rationale had another important advantage for science: it was powerful enough to fend off the democratic urges that usually guide the distribution of federal funds. Science is an elitist activity with a strong internal hierarchy that is at times difficult to reconcile with democratic processes and values, which hold that monies from a federal program should be allocated by geography or some similar populist standard. Recall that the Model Cities Program, which was supposed to demonstrate what a concentration of funds in a few locales could do to solve urban problems, soon awarded funds to nearly every city in the country, large or small. But it was weapons, perhaps another awesome innovation like the atomic bomb, that the public thought it was buying when it supported university research, and the public wanted the best weapons. If this meant that scientists rather than politicians controlled research allocations, so be it. Not surprisingly, under these arrangements, most of the money tended to concentrate at a few leading institutions—MIT, Stanford, and Cornell, among others—

where the scientific elite tended to congregate.

Following precedents set during World War II, federal agencies became generous benefactors of university-based research during the Cold War. Funds were made available for the support of graduate students and faculty summer stipends. Federal reporting requirements were kept to a minimum. Secrecy restrictions were rarely imposed. And, especially important to university administration, the government paid full overhead on grants as well as contracts; this meant that libraries as well as laboratories would be supported. Absent was the quibbling over cost sharing that usually beset awards from private foundations and nondefense-related agencies. Instead, under the security banner, the government was a willing collaborator in the expansion of the research universities, removing rather than imposing obstacles for growth.

When it first became apparent that federal funds would dominate support for science, some university administrators expressed concern about the stability of the support. After all, politics and programs could change. But even the Vietnam War protests, as disruptive as they were to campus life, did not alter the basic structure of the relationship. Into its fifth decade the Cold War had become a familiar, seemingly permanent part of the financial support system for academic research. It was a reliable base in an otherwise unreliable world.

Thus the collapse of the Soviet Union was likely a greater shock to university administrators than to the rest of us. Soon politicians found defense-research budgets and began diminishing them, earmarking funds for their favorite institutions at the expense of others. Soon government auditors began questioning administrative arrangements for contract-accounting practices that were once unchallengeable. And soon the military began to wonder why it was helping support research that was not particularly focused on military needs. The national-security rationale provided and protected a lot less well than it once did.

DURING the Cold War, government goodwill and ample federal funding flowed toward research and development. The science and engineering community, which has traditionally viewed deep involvement with the legislative process as distracting and somewhat degrading, could remain politically chaste.

But now that the major underlying justification for federally funded R&D has fallen away, the science and engineering community has suffered a rude awakening. The recently passed federal balanced-budget plan targets civilian R&D funding for a 35 percent reduction over the next seven years and numerous programs supporting higher education are on the chopping block as well.

Under federal budget procedure, science funding is lumped together with housing subsidies, prison construction, veterans benefits, dam and waterway maintenance, and a hundred other items that fall into the budget's "discretionary" pot of programs that must compete

SCIENTISTS AND ENGINEERS AS POLITICAL ADVOCATES



BY REP. GEORGE E. BROWN, JR.

annually for funding. Science is at a disadvantage in this situation because its benefits are uncertain, unquantifiable, and long-term. And unlike the constituencies for these other discretionary programs, the science and engineering community does not have a history

of strong political advocacy.

Researchers must not only do a better job of linking their work to a set of concrete national goals—of grounding that work in the present—but must also view their community as an integrated and politically sophisticated entity. Otherwise, better-organized interest groups will win the competition for sound government funding at both federal and state levels.

Splintered campaigns by narrowly defined scientific disciplines will not suffice. Efforts that pit funding for basic research against technology-development programs, for example, or biologists against chemists, will degrade the position of the entire R&D enterprise. Without a unified message to government policymakers, federal money that used to fund high-energy physics facilities will be used instead to build high-security corrections facilities.

The best mechanism for mobilizing widely scattered constituencies and delivering the message of the science and engineering community is the higher-education system and the various professional

The Replacement Rationale

But all was not lost. For a brief period, there seemed to be a near-perfect replacement rationale for research support, one that could garner significant public resources on its own. The 1980s had seen sustained hand-wringing about the declining industrial competitiveness of the United States. As the rivalry with the Soviet Union faded, the countries to fear—economically, if not militarily—became Japan and Germany, both recovered fully from World War II and dominating a great expansion in international trade. For some commentators, the United States was at risk once again. It was time, they believed, to tap the nation's technical and planning capabilities, so long in the near-exclusive service of national security, to revitalize its many lagging industries.

This argument found quick favor at universities and among the majority in Congress, where program after program was devised to aid industrial strength. Technology was to be transferred from the national laboratories to industry through cooperative agreements. Par-

ticular industries like semiconductors were to get special development assistance from the government. "Dual-use" technologies, amenable to defense and commercial applications alike, were to be promoted by the military. And monies would be made available for research on manufacturing processes, worker retraining, and technologies designated as critical, certain to constitute a long list once it had been through the political process.

Although administrators at major U.S. research universities endorsed the new rationale, they were not fully comfortable with it. This was in part because it was premised on an economic nationalism that clashed with the values of openness strongly held within academia. But it was also because the industrial-competitiveness rationale undermined the elite structure of science. If the support of science, including basic research, aided the country's economic strength, then so could it aid the economic strength of particular regions or states.

Congressional supporters sought to direct research funds, long immune from geographic politics, to their districts. Prestigious universities in Massachusetts and

societies. Advocacy will not threaten their tax-exempt status since it does not involve lobbying for specific legislative positions but is geared toward raising the visibility of the constituency for R&D programs in legislators' districts and states. The idea is to make elected representatives who will be deciding the fate of federal R&D funding aware of the value of science and engineering efforts to the nation. They need to see how these programs contribute to our economy and help develop a skilled population.

One way to drive the point home is to detail the short-term impacts of unthinking cuts to government programs. For instance, a little-known fact is that the higher-education community is one of the largest employment sectors in the nation, comprising nearly 2.5 million people both professional and nonprofessional. (By comparison, the entire U.S. motor-vehicle industry—the country's largest manufacturing sector—employs just under one million people.) In many regions, the university sector is the largest employer. Such is the case, for example, with the University of Maryland in that state and the Uni-

versity of Pittsburgh in that city. The bottom line is that large program cuts to R&D and higher education mean massive layoffs and losses of revenue.

The higher-education community can also build awareness of its value by inviting elected officials to visit campuses and laboratories. This will give researchers the opportunity to put abstract concepts into meaningful contexts and convey their excitement about their work and its implications. Inviting politicians to address groups of scientists and engineers is

**To preserve the
federal R&D effort,
researchers must
establish a long-neglected
dialogue with legislators
who allocate the funds.**



another effective educational and political-advocacy tool that is not lobbying. Even the sponsorship of candidate debates on campus or at local science-society chapters at election time, with a special focus on science and technology policy, does not cross the line. But you can be sure that such occasions will cause the victor to remember the science and engineering constituency after he or she is elected.

Whatever the specific approach to educating the political system about the value of stable science and technology funding—and the above suggestions are just a start—the research community must stress pragmatic and short-term returns on our R&D investment rather than the loftier goals of expanding human understanding. Given the pressures on legislators to address practical issues in the here and now, researchers' long-neglected dialogue with the political system must first focus on more immediate concerns. ■

GEORGE E. BROWN, JR. (D-Calif.), is ranking Democratic member and former chair of the House Science Committee.

California quickly found themselves in competition with ambitious if less-well-known universities in Florida, Arizona, and West Virginia that had more aggressive or better-placed congressional representation.

In November 1994, however, came the other once-in-40-year political event, as the Republicans won control of Congress. Industrial policy, except that formulated explicitly for defense, has long been anathema to Republicans. Although they were not opposed to the government's support of basic research, Republicans were on record as being against its support of applied research, and especially for developing commercial products, which they believe should be left entirely to entrepreneurs and the workings of the market. Thus all the programs so recently promoted as vital for the nation's industrial competitiveness have now been marked for extensive cuts or extinction.

Basic research merits support in the Republican view, at least in principle, because its benefits are broad-based, unpredictable, difficult to appropriate for private use, and thus not likely to be valued sufficiently by the mar-

ket. But without a persuasive political rationale—one that links public investments to urgent public purposes such as defense or jobs—basic research is not likely to gain significant governmental funding either. In truth, the promise of science is necessarily so long-term, so vague, so difficult for the public to accept when faced with so many immediate problems that politicians of any stripe are reluctant to push for large investments. In this sense politics has a myopia that is not much different from that of the market. Once again academic science is in need of a rationale.

A Never-Ending Quest

Health is the answer. And it is a rationale that serves both populist and elitist urges.

The public's interest in advancing health care is strong and personal. Protestations about their adherence to traditional religious beliefs notwithstanding, Americans do not seem at all anxious to meet their Maker; they in fact desperately seek to live longer, healthier lives.

EVEN IN A COST-CUTTING MODE, POLITICIANS COMPETE TO EXPAND HEALTH RESEARCH.

Therefore the importance of generating new knowledge to improve patient treatment, and the expertise of university-based specialists, are strongly supported by the American people, especially because funds for medical research are naturally geographically dispersed; medical schools are distributed around the country in general proportion to the population. Yet elitism finds a home in these schools and their affiliated teaching hospitals because, with their emphasis on research, they stand at the pinnacle of local health-care networks. Meanwhile, national accreditation standards keep quality levels high.

Americans may grouse about the high cost of health care, but they appear quite willing to spend mightily on it. In 1995 the country's total annual expenditures on health care exceeded a trillion dollars for the first time. Only occasionally in the last 30 years has the rate of growth in these expenditures fallen below the double-digit level. Not too long ago, we spent 14 percent of our gross domestic product on defense and 4 percent on health care. Today these percentages are reversed.

To be sure, much public and private effort is now directed toward reining in health-care costs. But whether the growth in expenditures is constrained or not, health-related research does not seem to be much at risk. It is both a relatively small part of the overall health-care budget and bipartisan in its popularity. For example, a recent hint that the budget of the National Institutes of Health would be trimmed to help reduce the deficit caused a stampede in the Senate that forced cuts in other domestic programs instead. In fact, it is easier to imagine the parties competing to *expand* health research, as they did in the 1970s to establish the campaign to conquer cancer, than it is to imagine them reducing expenditures on health research.

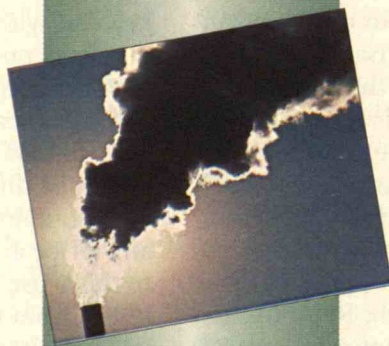
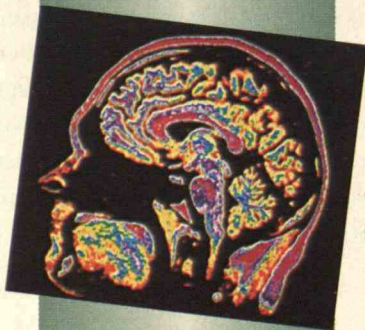
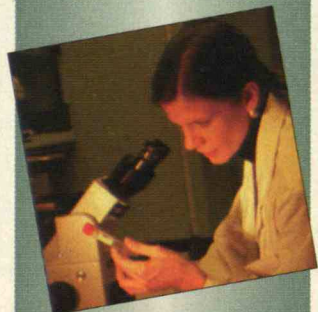
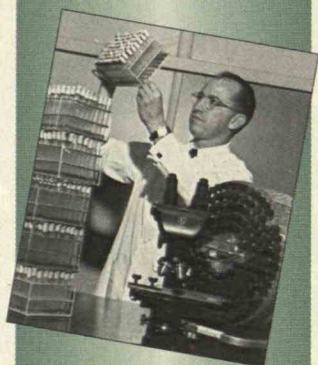
An emphasis on health R&D favors some disciplines over others, but not

greatly. Biology, of course, is the prime beneficiary. But nearly every discipline can claim a role. There is progress to be made, for example, across diverse areas of physics, chemistry, and engineering. And many diseases entail an important behavioral aspect that should not be neglected. The health-care rationale excludes virtually no one. It only challenges, as did the national-security and industrial-competitiveness rationales before it, the ingenuity of proposal writers.

Best of all, health is a rationale that is without a surprise. If we are clever enough, national security can be enhanced: wars can be won or prevented, and enemies can be deterred or converted into friends. Economic problems can also be solved. Productivity can be improved and rivals can stumble and fade. But we are prisoners of our biology. With the recognition of our mortality comes both an undeniable dread and an endless, if ultimately hopeless, quest.

Such cynicism when applied to science is not likely to be very welcomed by scientists. An obvious idealism underlies Bush's fourth rationale—the one most popular with scientists—that scientific research enhances the quality of life of the entire society. But even scientists will admit that citizens will not likely tax themselves heavily to support what so few among them can understand, let alone practice. To gain public allocations for science, more has to be offered than the elegance of the work or promises of long-term but unspecifiable benefits.

It is fear that motivates—the fear of communist expansion, the fear of Japanese or German economic dominance, the fear of natural death. The first of these fears has largely dissipated, the second has become a no-show for serious support of scientific research. The third, however, is an enduring part of the human condition and, I believe, the last best hope for academic science. ■



TECHNOLOGY UPDATE

900 MHz breakthrough!

New technology launches wireless speaker revolution...

Recoton develops breakthrough technology which transmits stereo sound through walls, ceilings and floors up to 150 feet.

by Charles Anton

If you had to name just one new product "the most innovative of the year," what would you choose? Well, at the recent *International Consumer Electronics Show*, critics gave Recoton's new wireless stereo speaker system the *Design and Engineering Award* for being the "most innovative and outstanding new product."

Recoton was able to introduce this whole new generation of powerful wireless speakers due to the advent of 900 MHz technology. This newly approved breakthrough enables Recoton's wireless speakers to rival the sound of expensive wired speakers.

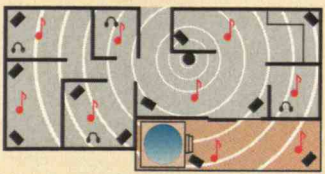
Recently approved technology.

In June of 1989, the *Federal Communications Commission* allocated a band of radio frequencies stretching from 902 to 928 MHz for wireless, in-home product applications. Recoton, one of the world's leading wireless speaker manufacturers, took advantage of the FCC ruling by creating and introducing a new speaker system that utilizes the recently approved frequency band to transmit clearer, stronger stereo signals throughout your home.

**150 foot range through walls!**

Recoton gives you the freedom to listen to music wherever you want. Your music is no longer limited to the room your stereo is in. With the wireless headphones you can listen to your TV, stereo or CD player while you move freely between rooms, exercise or do other activities. And unlike infrared headphones, you don't have to be in a line-of-sight with the transmitter, giving you a full 150 foot range.

The headphones and speakers have their own built-in receiver, so no wires are needed between you and your stereo. One transmitter operates an unlimited number of speakers and headphones.



Recoton's transmitter sends music through walls to wireless speakers over a 70,000 square foot area.

Crystal-clear sound anywhere.

Just imagine listening to your stereo, TV, VCR or CD player in any room of your home—without running miles of speaker wire. Plus, you'll never have to worry about range because the new 900 MHz technology allows stereo signals to travel distances of up to 150 feet through walls, ceilings and floors without losing sound quality.

A single transmitter, unlimited receivers.

The powerful transmitter plugs into an audio-out, tape-out or headphone jack on your stereo or TV component, transmitting wirelessly to speakers or headphones. The speakers plug into an outlet. One transmitter broadcasts to an unlimited number of stereo speakers and headphones. And since each speaker contains its own built-in receiver/amplifier, there are no wires running from the stereo to the speakers.

Full dynamic range.

The speaker, mounted in a bookshelf-sized acoustically constructed cabinet, provides a two-way bass reflex design for individual bass boost control. Full dynamic range is achieved by the use of a 2" tweeter and 4" woofer. Plus, automatic digital lock-in tuning guarantees optimum reception and eliminates drift. The new



Breakthrough wireless speaker design blankets your home with music.

technology provides static-free sound in virtually any environment. The speakers are also self-amplified; they can't be blown out no matter what your stereo's wattage.

Stereo or hi-fi, you decide. These speakers have the option of either stereo or hi-fi sound. Use two speakers (one set on right channel and the other on left) for full stereo separation. Or, if you just want to add an extra speaker to a room, set it on mono and listen to both channels on one speaker. Mono combines both left and right channels for hi-fi sound. This option lets you put a pair of speakers in the den and get full stereo separation or put one speaker in the kitchen for hi-fi sound.

Factory-direct savings. Our factory-direct pricing allows us to sell more wireless speakers than anyone! For this reason, you can get these speakers far below retail with our 90-day risk-free home trial."

Add headphones and save \$100. For a limited time, when you order two speakers and a transmitter, you can add wireless headphones



for only \$49. That's a savings of \$100 off the price of the headphone system. This exclusive offer is available only through Comtrad. Your order will be processed within 72 hours and shipped UPS.

AWARD WINNING WIRELESS SPEAKER

Built-in receiver and amplifier:

The wireless speaker and headphones both contain a built-in receiver and amplifier. Signals are picked up and transmitted as far as 150 feet away through walls without the use of wires.



Size: 9"H x 6"W x 5.5"L
Signal-to-noise ratio: 60 dB
Channel Separation: 30 dB
Two-way bass reflex design
10 watts/channel RMS amps
Frequency Response: 50 Hz-15 KHz

Don't take our word for it. Try it yourself. We're so sure you'll love the new award-winning Recoton wireless speaker system that we offer you the **Dare to Compare Speaker Challenge**. Compare Recoton's rich sound quality to that of any \$200 wired speaker. If you're not completely convinced that these wireless speakers offer the same outstanding sound quality as wired speakers, simply return them within 90 days for a full "No Questions Asked" refund.

Recoton's Design and Engineering Award



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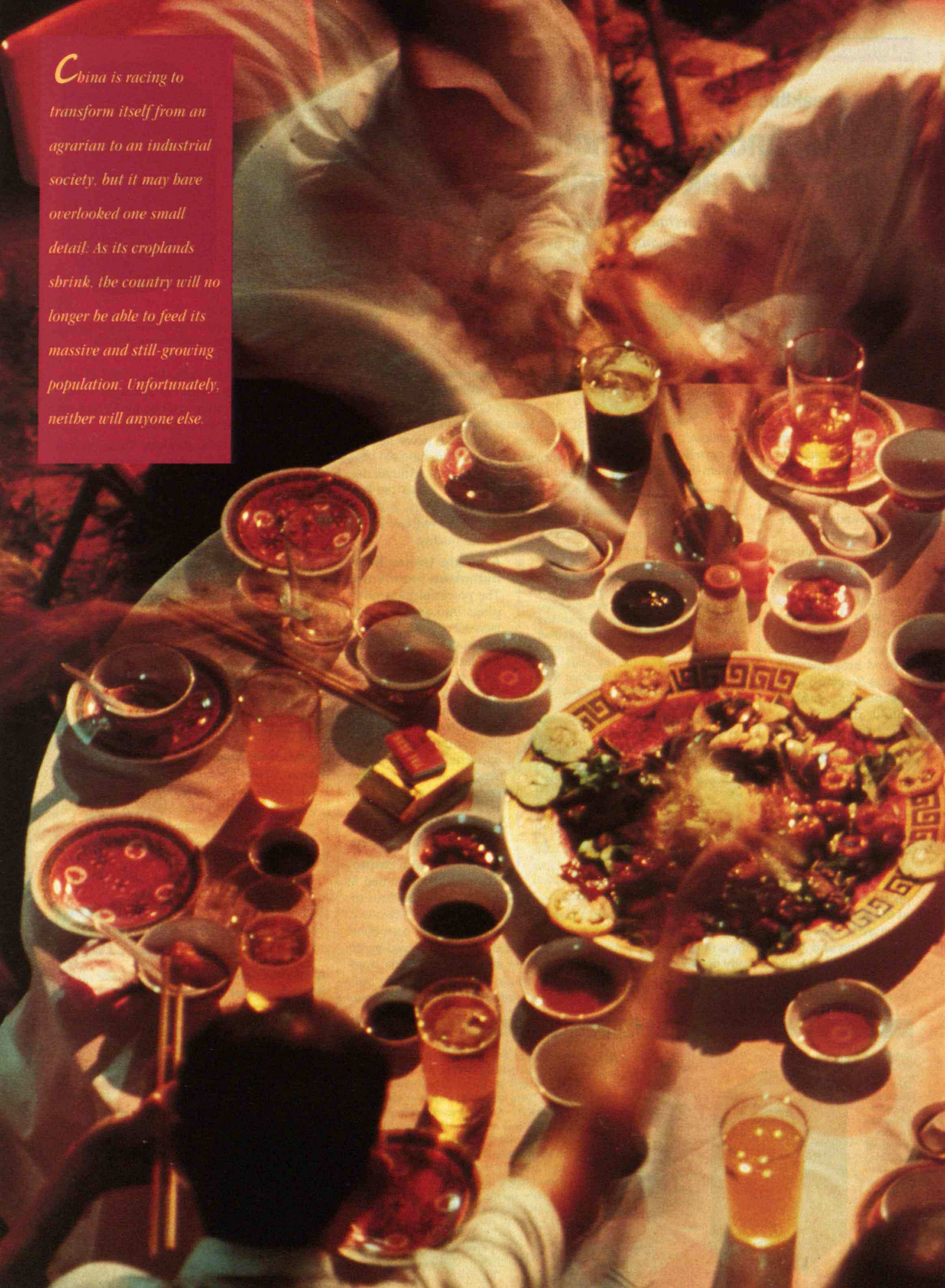


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China is racing to transform itself from an agrarian to an industrial society, but it may have overlooked one small detail: As its croplands shrink, the country will no longer be able to feed its massive and still-growing population. Unfortunately, neither will anyone else.





By LESTER BROWN

Averting A Global Food Crisis

THIS past February, while giving a speech in Oslo, Norway, at a conference on sustainable development, I illustrated some of the global dilemmas that lay ahead as a result of China's headlong dash toward industrialization. I suggested that when countries become densely populated before they begin to industrialize, as is the case with China, they inevitably suffer a heavy loss in grainland as farms are devoured by factories, roads, and parking lots. If industrialization is rapid, land losses quickly outstrip rises in agricultural productivity, which leads to a decline in grain production.

PHOTO: WESTLIGHT/R. IAN LLOYD

Ironically, the same industrialization that shrinks grain harvests also raises income and with it the demand for grain. Indeed, given the opportunity, people will quickly shift from a monotonous fare—in which a staple such as rice supplies the bulk of calories—to one that includes a substantial portion of pork, beef, poultry, milk, eggs, and other livestock products. Unfortunately, these items require more grain than would otherwise be consumed in a starchy diet. For example, 4 kilograms of grain are needed to produce 1 kilogram of pork, and 7 kilograms of grain are needed for 1 kilogram of beef.

I pointed out that before China, only three countries—Japan, South Korea, and Taiwan—were densely populated before they industrialized. Within 30 years, each had lost more than 40 percent of its grainland. And since the huge losses could not be offset by productivity gains, grain output fell in Japan by 32 percent

grain that the United States and all the rest of the exporting countries combined will not be able to meet the need. For the first time in history, the collision between expanding human demand for food and the earth's natural limits will produce devastating effects worldwide. Because of China's effect on our global economy, its land scarcity will become everyone's land scarcity, its grain shortages will become everyone's grain shortages, and its rising food prices will spread throughout the world.

In short, I proposed that China's emergence as a massive grain importer will serve as the "wake-up call" signaling trouble in the relationship between ourselves and the natural systems and resources on which we depend. It will force governments everywhere to address long-neglected issues such as the need to stabilize population, to rethink agricultural priorities, and to redefine security in terms of food scarcity rather than military aggression.

If China's croplands shrink and its population swells at present rates, the total amount of grain will be one-tenth the present U.S. figure in the next three decades, creating an import deficit in China.

and in both South Korea and Taiwan by 24 percent. Add to this equation the widespread demand by the suddenly affluent populations for greater diversity in their diets, and the three countries went from being largely self-sufficient to collectively importing 71 percent of their grain needs. In no case was the heavy dependence on imports a conscious policy goal, but rather it was the result of industrialization in a region of land scarcity.

While the problem was severe for these three smaller countries, I showed that it will be overwhelming in China, with its immense and rapidly growing population—which at nearly 1.2 billion is 10 times larger than that of Japan and amounts to more than one-fifth of the world's population. Meanwhile, the country is on track for adding some 490 million people between 1990 and 2030—the equivalent of four Japans—swelling its population to more than 1.6 billion. Moreover, in China's increasingly industrial society, incomes are rising faster for more people than ever before in history. If the country's economy continues growing at its breakneck pace—it has expanded by a phenomenal 56 percent in just four years—China could overtake the United States as the world's largest economy by 2010 and will accelerate its demand for more food at a record rate.

China could thus become such a massive importer of

CHINA'S REBUTTAL, AND ADMISSION

Following the presentation, which was well received, I had to leave after the coffee break for the airport. Later I learned that when the session reconvened, the Chinese ambassador to Norway, Xie Zhenhua, asked for the floor even though he was not a scheduled speaker. According to the *Times of India*, one of the papers covering the conference, the ambassador claimed that my analysis was off-base and misleading. "We are giving priority to agricultural productivity," he said. "Our family-planning program has been very successful. Science and technology and economic growth will see us through." In concluding, he repeated the question I had asked—"Who will feed China?"—and solemnly proclaimed to the audience that "the Chinese people will feed themselves." The following day, Xie held a news conference, and contended "unequivocally that China does not want to rely on others to feed its people and

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that it relies on itself to solve its own problems.”

Although I was aware that the Chinese were sensitive to the notion that they might need to import large amounts of grain, I had not realized just how politically charged the issue is. All the leaders of China today are survivors of the massive famine that occurred from 1959 to 1961 in the aftermath of the “Great Leap Forward.” This misguided effort under Mao Tse-tung to employ millions of farmers in large construction projects—including roads, huge earthen dams, and backyard steel furnaces—sharply reduced food production, claiming a staggering 30 million lives and driving perhaps a few hundred million more to the edge of starvation. The national psyche of China has been so deeply affected by this devastating event that the prospect of depending on the outside world for a substantial share of the country’s food supply is both psychologically difficult to accept and politically anathema.

EBBING WAVES OF GRAIN

China’s cropland crisis can be blamed partly on the country’s geography. Although China covers essentially the same land area as the United States, much of the country is desert and mountain. In fact, only one-tenth of the land—most of it a 1,000 mile-wide strip along

the eastern and southern coasts—is cultivable.

Given that China has the largest population on the planet, this relatively meager allotment means that China ranks among nations with the smallest amount of grainland per person. In fact, in 1990, grainland per person was 0.08 hectares, less than one-third that of the United States.

Since 1990, however, harvested grainland area dropped from 90.8 million hectares to 85.7 million. This decline of 5.6 percent in four years, combined with a 4.9 percent population growth totaling 59 million people, reduced the harvested area per person by just over 10 percent. If the trend continues, grainland per person will dwindle

to 0.03 hectares by 2030. By the time Japan reached this point, it was importing two-thirds of its grain.

The major factor contributing to such losses is the conversion of cropland to nonfarm uses. Today China’s labor force totals nearly 800 million people, most of whom work in agriculture. A shift of only 100 million workers from the farm labor force to the industrial sector over the next decade or so—assuming roughly 100 workers per factory (about par for China’s private sector)—would require construction of 1 million factories.

These factories will consume valuable cropland, since they will be constructed where the people are and the people are concentrated where the cropland is. (Wastelands in the western half of the country contain so little water that they can’t support even dry-land crops much



*inland per person will dwindle to about
it may be twice the current level of world exports.*

As it happened, however, during the time when my indirect dialogue with Chinese officialdom was taking place, the food situation was already tightening within China. In late February, a Reuters story referred to the “sounding of alarm bells” by Communist Party chief and President Jiang Zemin and by Premier Li Peng regarding the state of the country’s agriculture. Premier Li talked about 1995 being “significant for the increase of grain output, and the task is a very hard one.” President Jiang warned that “lagging agricultural growth could spawn problems that would threaten inflation, stability, and national economic development.” He indicated that some developed coastal areas where industrialization was particularly rapid had suffered a precipitous drop in the amount of acreage under cultivation, saying that this is “a trend that must be reversed...this year.”

Accounts of the National People’s Congress meeting in mid-March said officials acknowledged that “China is facing a looming grain crisis, with a hike in imports the only apparent solution to the demands of a growing population on a shrinking farmland.” Experts cited “a series of vicious circles that threatened to lock grain production into a downward spiral.” Such extensive consideration of the matter at the Congress suggests that feeding China is indeed now a pressing matter of official concern.

less cities and industries—and the cost of transporting water from the southeast would be prohibitive.) The factories also need access roads and parking lots as well as warehouses to store raw materials and finished products.

Residential demands are also claiming cropland. The 490 million people added to China's population between 1990 and 2030 will have to be housed. If each family consists of five individuals—a married couple, one child, and one set of in-laws—the additional people will require 98 million more housing units. Whether this need is satisfied with apartments or freestanding homes, it will consume a vast area of land, much of it cropland.

A consequence of rising affluence is an increase in the living space per person. In many cases, villagers are expanding their homes, adding a room or two. Others are simply building new, much larger homes. In Japan, by way of comparison, floor space per person expanded from 20.5 square meters in 1970 to 28.6

square meters in 1990, an increase of more than one-third. Given China's nationwide housing shortage and the extent of its crowding, this trend set in Japan will likely be followed in China as incomes rise.

Automobiles, too, are "consuming" cropland. In an industrial policy announced in July 1994, Beijing indicated that automobiles are to become one of the major growth industries during the next two decades. Ironically, even as the Ministry of Agriculture is calling for new measures to protect cropland, the Ministry for Machinery Building is pressing for a massive expansion of the automobile fleet and planning incentives that will encourage people to trade their trusty bicycles for cars.

Annual sales of cars, vans, trucks, and buses, which totaled 1.2 million in 1992, are expected to approach 3 million by decade's end. By 2010, ministry projections show production of automobiles above 3.5 million per year. Meanwhile, the car fleet is projected to grow from

1.85 million in 1994 to 22 million by 2010. A fleet of this size will require millions of hectares of land for a network of roads, highways, service stations, and parking lots. And as with factories, these will have to be built where the people are.

Finally, farmland is being claimed by shopping centers, tennis courts, golf courses, and private villas. In rapidly industrializing Guangdong province, for example, some 40 golf courses have been built in the newly affluent Pearl River Delta region alone. Concern about this wholesale loss of cropland has led the Guangdong Land Bureau to cancel construction of all golf courses planned but not yet completed.

Chinese political leaders may be tempted to think that they can somehow avoid a massive loss of cropland to nonfarm uses. But if they look at the experience in Japan, they will see how difficult protecting cropland can be. Few governments have worked as strenuously at this as Japan did with its



Though as many as 300 Chinese cities face farmers—who now rely on irrigated fields for

system of zoning. For example, some 13,000 Japanese families grow rice within the Tokyo city limits; if this land were released for sale, it might be worth easily 100 times its value as farmland. But even with such concentrated efforts, Japan lost half its grainland during the last four decades.

If China maintains its present course, the country will likely lose at least as much of its grainland to industrialization in the same span of time.

SPREADING WATER SCARCITY

Along with the continuing disappearance of farmland, China faces another threat to food production—one that its trio of neighbors did not: water scarcity from an extensive diversion of irrigation water to nonfarm uses. This is an acute concern in a country where nearly four-fifths of the harvest comes from irrigated land.

As recently as mid-century, water supplies in China were abundant relative to demand. Surface and underground sources together could more than satisfy the needs of the country's 500 million people. Since then, however, the water supply-demand ratio has decreased as water use has increased sixfold as a result of population growth, expanding irrigation, rising affluence, and industrialization. Water scarcity became extreme enough in 1993 for that Minister of Water Resources

Niu Mao Sheng to observe that "in rural areas, more than 82 million people find it difficult to procure water. In urban areas, the shortages are even worse: more than 300 Chinese cities are short of water and 100 of them are very short."

The most severe water shortages are being felt in the northern half of China. That's largely because the area north of the Yangtze River encompasses nearly two-thirds of the country's cropland, yet it holds only one-fifth of the total surface water. In contrast, more than four-fifths of the surface water in China is found in the Yangtze and other river basins in the south, which has only 37 percent of the country's cropland.

The situation is most acute in the northern province. In Shanxi, where one-tenth of the peasants face chronic shortages of drinking water, farmers are limited to using far less water for irrigation than they need. In fact, one-quarter of the province's irrigated fields cannot be guaranteed water during the growing season. Likewise, bur-

The central question, therefore, is whether Chinese Ambassador Xie Zhenhua's proclamation—that China's farmers can raise grain yield per hectare fast enough to offset any loss of cropland—will come true. Alas, data for the four years since 1990 indicate that they are losing the race, just as farmers in Japan, South Korea, and Taiwan did two or three decades earlier.

Since mid-century, changes in China's grain productivity break down into four distinct periods. In the first, from 1950 to 1977, productivity per hectare doubled. One of the keys to this gain was an expansion of irrigated areas along with the adoption of higher-yielding varieties of wheat and rice, developments that paralleled those in other Asian countries participating in the Green Revolution.

The most dynamic period in China's recent agricultural history occurred from 1977 to 1984, when the nation led the world by raising grain yield per hectare by 62 percent, posting a phenomenal annual rate of nearly

severe water shortages, demand will more than double in the next 30 years. Thus many of China's four-fifths of the country's harvest—will soon be forced to revert to lower-output rain-fed crops.

geoning water demand in Beijing, also located in the north, has produced such severe water shortages that farmers in the region immediately around the city were recently banned from the reservoirs from which they traditionally draw irrigation water. With 300 cities in China already short of water, it is likely that in the years ahead farmers near many other urban areas will be forced to join those around Beijing who have reverted to less intensive rain-fed farming.

Meanwhile, water needs in China are expected to continue growing at a rapid pace in all sectors. Industry's use of water, now growing by more than 11 percent a year, could easily double within seven years. In agriculture, the combination of a population reaching 1.6 billion by 2030 and the continuing rise of individual consumption of livestock products, could nearly double the demand for water over today's levels. And in the residential sector, though families often share sanitary facilities and use only 10 gallons of water per person daily, millions more every year are moving into homes with indoor plumbing, where they can easily double or triple their consumption.

DON'T COUNT ON BOOSTING PRODUCTIVITY

In a country where the land area devoted to crops is no longer expanding, as in China, future growth in food output can come only from raising land productivity.

7.1 percent. The 1978 economic reforms, which broke up farm production teams and returned farmers to family farm units, triggered the Agricultural Revolution and with it a dramatic rise in the use of fertilizer, which was primarily responsible for the phenomenal growth. After 1984, however, raising productivity proved more difficult. As gains from irrigation and fertilizer use peaked, yields slowed, growing less than 2 percent a year through 1990. Then from 1990 to 1994, yield per hectare rose even more slowly, edging up only 0.7 percent per year.

Improving productivity further will require raising yields of the three crops that occupy most of China's farmland: rice, wheat, and corn, each of which accounts for roughly 100 million tons of the 340 million-ton annual grain harvest. Rice and wheat, of course, are the two national staples, with rice dominating in the south and wheat in the north. Some corn is also consumed as food but most of that harvest is now fed to livestock.

Of these grains, rice appears to hold the greatest promise for productivity gains. In fact, in the fall of 1994 the International Rice Research Institute in the Philippines, the world's leading center for rice breeding, announced that it had designed a rice variety that would lift yields 20 to 25 percent above the highest-yielding varieties now available in Asia (see "A Job for

Super Rice," *TR August/September 1995*, page 20). By cross-breeding the highest-yielding varieties created during the Green Revolution, scientists essentially designed a plant that boosts the share of metabolic energy it devotes to the formation of seeds, thus raising the amount of grain produced per hectare. But even if the so-called super rice is successful and boosts yields by the maximum 25 percent, it would add only about 30 million tons to the country's harvest—just one-tenth of the projected growth in demand for grain between now and 2030.

As with rice, China can boast of an impressive history in boosting wheat production: from 1975 to 1984, yields climbed 81 percent, a remarkable gain for such a large country. But here, too, growth has since slowed considerably: during the past 10 years, productivity has risen only 17 percent. And with water scarcity reducing irrigation application rates in the north where wheat is grown, achieving greater yields

ing the last four years suggests that the loss of cropland is already offsetting modest gains in land productivity. Indeed, as harvested grain area shrank by 5.6 percent between 1990 and 1994, grain yield per hectare rose by 2.8 percent, which translates into a total decline in grain harvest of 2.8 percent, or 0.7 percent a year.

This suggests that the long-term decline in grain output that accompanied industrialization in Japan, South Korea, and Taiwan may now have begun in China. Indeed, once the decline in Japan's grain production got under way after 1960, output fell by roughly 1 percent a year for more than 30 years, accounting for some 32 percent in total. In looking ahead to 2030, a conservative assumption would be that China's grain production would fall by at least 20 percent. If this happens, the 1990 harvest of 340 million tons would fall to 272 million tons by 2030.

In projecting China's potential grain demand, two scenarios can be considered. Under the first, demand

Hopes have faded that biotechnology will provide the necessary doubling or tripling in the yields of grain crops that occupy most of China's farmland. The science has failed to produce a single dramatic gain in yield.

may become progressively more difficult.

China has made similarly impressive progress with corn, but production per hectare is still scarcely 60 percent of that in the United States. This gap could narrow somewhat, but few countries can approach the yields achieved in the U.S. Corn Belt, which has an ideal combination of deep soils, temperatures, day length, and rainfall, the latter near-optimal in both annual amount and seasonal distribution.

At one time, there was high hope that biotechnology would create another generation of high-yielding strains that would greatly increase yields, much like the earlier generation of varieties produced by conventional plant breeding. Unfortunately, this hope has faded as biotechnology has failed to produce a single dramatic yield gain for any grain in more than 20 years. The prudent assumption, therefore, is that there is not likely to be another generation of grains that will double or triple the yield of existing varieties. Yet production improvements of that scale will be required.

A GROWING DEFICIT

Even allowing for some boosts in rice yields from research such as the super rice prototype, the long-term prospect for large additional rice yield increases in China is not bright. The plateauing in grain production dur-

increases only as a result of population growth and there are no further rises in per capita consumption of meat, milk, eggs, or other food products dependent on the use of grain. The second scenario assumes that the Chinese people continue their recent move up the food chain, albeit at a much slower rate than that of Japan. It suggests that the current annual consumption of just under 300 kilograms of grain per person, including that consumed directly as well as that consumed indirectly in the form of livestock products and alcoholic beverages, will increase to 400 kilograms by the year 2030, roughly the same as Taiwan today and half the U.S. per capita grain consumption of more than 800 kilograms per year.

Under both scenarios, the resulting grain deficit is huge, many times that of Japan—currently the world's largest grain importer. In 1990, China produced 340 million tons of grain and consumed 346 million tons. In the first scenario, allowing only for the projected population increase, China's demand for grain would increase to 479 million tons in 2030. Given a projected 20 percent drop in grain production to 272 million tons, as explained earlier, this would leave a shortfall of 207 million tons—roughly equal to the world's entire 1994 grain exports.

But China's newly affluent millions will not likely be content to forgo further increases in consumption of

livestock products. If per capita grain consumption climbs to 400 kilograms in the year 2030, total demand for grain will reach a staggering 641 million tons. Under this scenario, the import deficit would reach 369 million tons, nearly double current world grain exports.

While China's political leaders are reluctant to recognize the possibility of so large a grain deficit, at least one Chinese scientist has made calculations similar to these. Professor Zhou Guangzhao, head of the Chinese Academy of Sciences, observes that if consumption per person nationwide reaches the level of the most affluent coastal provinces (about the same level as Taiwan) and if the nation continues to squander its farmland and water resources in an all-out effort to industrialize, "then China will have to import 400 million tons of grain per year from the world market."

million tons of grain at current prices would be within economic range if the country's leaders were willing to use a share of export earnings for this purpose.

The more difficult question is, who could supply grain on this scale? The answer: no one. No single exporting country nor even all of them together can likely expand exports enough to cover more than a small part of this huge additional claim on the world's exportable grain surplus.

The handful of countries that traditionally produce an exportable grain surplus—including the United States, Canada, Australia, Argentina, and Thailand—face a number of similar constraints to raising yields. For example, in the United States, which accounts for half the world grain exports, the diversion of irrigation water to satisfy the demands of Sun Belt cities—such as Los Angeles, Phoenix, Tucson, Las Vegas, El Paso, and Denver—will reduce the water available to farmers in the southern Great Plains and the Southwest during the next four decades. Also, as the U.S. population swells by some 95 million in this period, the country's cropland

will shrink as these new Americans will need the space to build approximately 30 million houses and apartments and a proportionate number of factories, schools, churches, shopping malls, golf courses, cars, roads, and parking lots. Finally, this growing population will demand some 75 million tons of additional grain for its own consumption.

FOOD: THE NEW THREAT TO SECURITY

Even as China is facing the potential need for massive imports of grain, many other countries are in a similar situation. For example, six of the world's more popu-



Production of rice, wheat, and corn—the crops that have sustained the yield of any grain in more than 20 years.

WHO WILL FEED CHINA?

In confronting such a deficit, two key questions arise: Will China have enough foreign exchange to import the grain it needs? And will the grain be available? On the first count, if the premise underlying this demand is a continuation of the economic boom, there would likely be ample income from industrial exports to pay for the needed grain imports at current prices. Since China's economic reforms were launched in 1978, nonagricultural exports have been growing at a prodigious rate, surpassing \$100 billion for the first time last year. Moreover, record levels of foreign investment by global corporations—designed largely to capitalize on China's vast pool of low-wage labor—will help ensure competitiveness in world markets and increase exports.

Filling a 100-million-ton import deficit, which is equal to nearly half of current world grain exports, by bringing in wheat or corn at 1994 prices of roughly \$150 a ton would require \$15 billion. But given its trade surplus with the United States alone, which in 1994 reached nearly \$30 billion, China could buy all U.S. grain exports—grain that now goes to more than 120 grain-deficit countries—even if grain prices doubled. Given the likely continuing growth in China's nonagricultural exports, importing 200 million or even 300

lous developing countries—Iran, Nigeria, Ethiopia, Pakistan, Bangladesh, and Egypt—are expected to double or triple in population over the next four decades. These and other growing countries—including India, Brazil, Mexico, and Eritrea—face huge grain deficits. In 1990, this group of 10 nations imported 32 million tons of grain, roughly one-sixth of the world total. By 2030—assuming no change in diet—they will need to import 190 million tons, six times the amount they import today and nearly equal to total world grain exports in 1994.

The point of these projections is that competition for grain imports in the years ahead is likely to intensify dramatically even without China's emergence as a massive importer. This suggests that the world grain market soon will be converted from a buyer's to a seller's market. From mid-century through the early nineties, strong competition among exporting countries substantially lowered the real price of grain. This created an ideal environment for alleviating hunger as even low-income countries with limited foreign exchange enjoyed gradually declining outlays for grain imports. But in a seller's market, importing countries will soon find themselves competing vigorously for supplies of grain that never seem adequate, and at ever-increasing prices.

Thus, as the world contemplates the prospect of scarcity, it must face the issue of distribution. As long as the economic pie was expanding more rapidly than population was growing, political leaders could always urge the poor to be patient because eventually their share would also increase. But if the food supply is expanding much more slowly than population, the question of how the pie is divided becomes a much more immediate political issue.

One way of distributing scarce resources is to let the market do its job. Indeed, given the economic reforms in the former Soviet Union and China, reliance on the market to distribute food is now nearly worldwide. Whenever demand outruns supply, the price rises, reducing demand while encouraging additional supply.

From a purely economic standpoint, the market does a good job of balancing demand and supply and distributing food. But from a social point of view, rising food prices can quickly produce a life-threatening situ-

ation for the world's poorest. For the Third World's rural landless and its shantytown residents who already may spend 70 percent of their income on food, even a modest rise in food prices can threaten survival. In a global economy, rising food prices could jeopardize security in food-importing countries worldwide, leading to potentially unmanageable inflation, abrupt shifts in currency exchange rates, widespread political unrest, and even swelling flows of hungry migrants across national borders.

SETTING PRIORITIES

Clearly, the most urgent need is to stabilize world population, and thus the demand for food, as soon as possible. China's leaders took a step in the right direction in 1979 when, faced with a trade-off between smaller families in the present or deteriorating living conditions in the future, they



A tax on the consumption of beef, pork, and poultry, otherwise be consumed in a starch

instituted a "one-couple, one-child" policy. As a result, China's population growth rate has dropped from 2.7 percent to 1.1 percent, and is now roughly the same as that of the United States. Still, implementing the one-child-per-family policy has become more difficult in recent years, as some families are becoming so affluent that they can readily pay the stiff penalty for having more children.

Meanwhile, the goals of the World Population Plan of Action—adopted at the United Nations Conference on Population and Development in Cairo in September 1994—may not be ambitious enough. The plan calls for achieving universal, primary-level education for all young women, which by itself is expected to reduce birth rates, and to implement family-planning practices more widely. But some densely populated developing countries may have to choose between quickly reducing family size to "replacement level," that is, no more than two children per family, or accept a decline in food consumption per person in the decades ahead.

Another top priority is to expand food production by conserving water. For example, water marketing—pricing water at full cost—would reduce wasteful use and encourage investment in water-efficient technologies and practices in agriculture, industry, and cities. Avoid-

ing acute water scarcity depends on investing in water efficiency on a scale comparable to the investment in energy efficiency in the mid-seventies, and thus buying more time to stabilize population.

Many countries also need to take steps to actively protect cropland from nonfarm uses. One of the principal threats to the world's cropland is the trend toward automobile-centered transportation systems: the evolution of such systems not only leads to the extensive paving of cropland, but it also encourages land-consuming urban sprawl. The alternative is a combination of public transport and bicycles.

With world grain stocks at their lowest level in 20 years and with the prospect of spreading food scarcity, we need an inventory of the various reserves that can be tapped to alleviate scarcity and buy time to stabilize population, now growing by 90 million per year. The most easily tapped reserve is the cropland in the United States and Europe that is idled under supply management programs that are designed to avoid surpluses. If

By far the largest food reserve is the 37 percent of the world grain harvest, some 630 million tons in 1994, used to produce livestock and poultry products for human consumption. To some degree, rising grain prices will push up prices of livestock products and reduce their consumption. But the price level at which a substantial reduction occurs is so high that it could force food consumption among millions of the world's poor below the survival level. Rationing the consumption of livestock products in the more affluent societies would free up grain without leading to dramatic price rises.

The same reduction in consumption could be achieved by imposing a tax on consumption of livestock products, one that would be similar to those that governments put on alcoholic beverages and cigarettes. Such a tax could affect eating habits not only in industrial countries but in developing ones as well, as China is now the world's largest consumer of red meat. Reducing the 630 million tons of grain used for feed

poultry, eggs, and other livestock products—which require far more grain to produce than would be—would be unpopular but could be one means of ensuring global stability in an era of scarcity.

this land were returned to production in 1996, it could boost the world grain harvest by an estimated 34 million tons, enough to cover the demand stemming from world population growth for 15 months.

Another source of land for food production is the fields used to grow nonfood products such as tobacco. If the 5 million hectares of cropland now devoted to tobacco growing were switched to grain, assuming the average world yield of 2.4 tons per hectare, the production would provide enough grain to support the growth in world population for nearly six months.

Almost as large a potential source of food is the 1.4 million hectares of highly productive U.S. cornland that now produces the 11 million tons of corn annually used to make roughly 1 billion gallons of ethanol for use as an automotive fuel. Making this grain available for human consumption could cover four months of world population growth.

The area now growing cotton could also be reduced. If consumers could be persuaded to replace half of the cotton clothing they buy with clothes made from synthetic fibers, some 9 million hectares of land worldwide would be freed up, providing enough grain for 11 months of world population growth. China, the world's leading cotton consumer, is already investing heavily in the manufacture of synthetic fibers on a scale that could eventually lower demand for cotton.

by 10 percent would free up 63 million tons of grain for direct consumption—enough to cover world population growth for 28 months. Unprecedented and unpopular though a livestock-products tax would be, it could be the price of global stability in an era of scarcity.

Beyond this, an international food-reserve organization is urgently needed—one that would acquire stocks when prices are low in order to release them when they are higher, thus helping to stabilize food prices.

Finally, there is a need for much greater global investment in agricultural research. Although the likelihood of another breakthrough like the development of hybrid corn or the discovery of chemical fertilizer is low, in a world of food scarcity every technological advance that helps expand production, however small, is important.

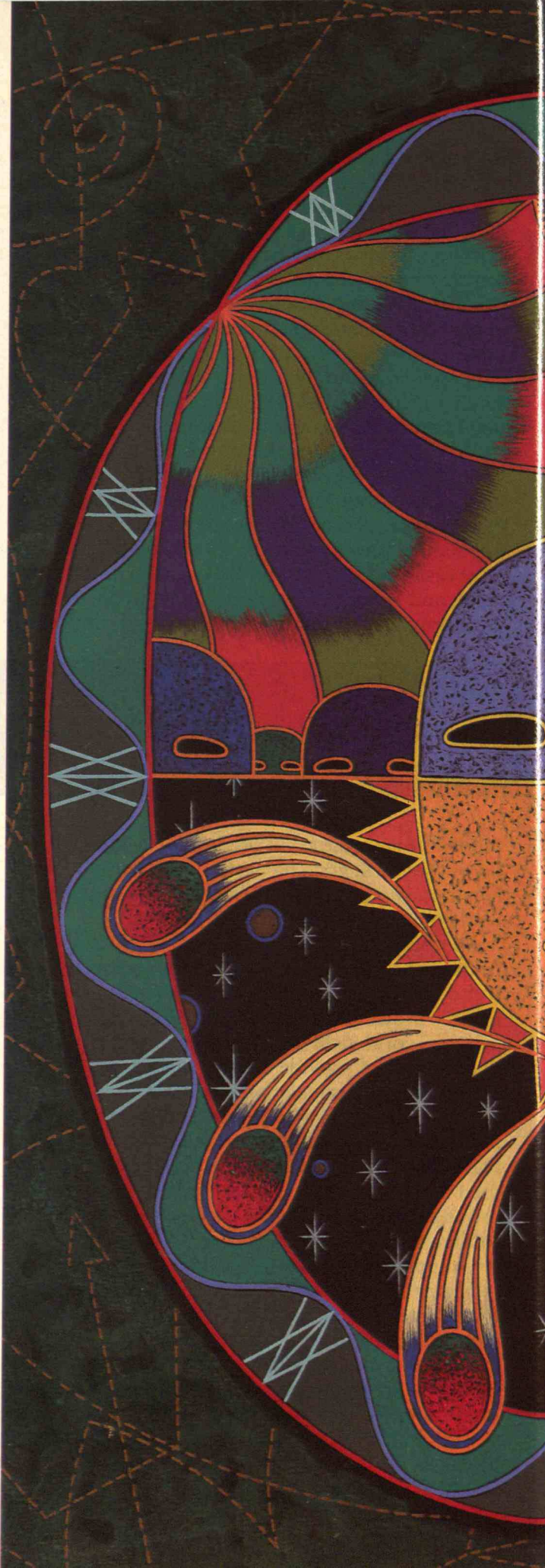
Effectively addressing the threat of food scarcity to our future will take a massive mobilization of resources, both financial and political. But if we really care, we have no choice but to launch such an effort. For our generation, the overriding issue is whether we can reestablish a stable relationship between our numbers and aspirations on the one hand and the earth's natural support systems on the other. Unless we act quickly and decisively, neither history nor our children will judge us kindly. ■

WHEN THE UNIVERSE BEGAN, WHAT TIME WAS IT?

*To learn how the cosmos blossomed
out of a subatomic point, theorists must first
settle a fundamental question of chronology:
Is there some hypothetical clock that can
track the sequence of events, or is time,
at the smallest of physical scales, irrelevant?*

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T I M E

is an elusive notion. Poets often think of time as a river, a free-flowing stream that carries us from the radiant morning of birth to the golden twilight of old age. It is the span that separates the delicate bud of spring from the lush flower of summer.

• • • • • Physicists think of time in somewhat more practical terms. For them, time is a means of measuring change—an endless series of instants that, strung together like beads, turn an uncertain future into the present and the present into a definite past. The very concept of time allows researchers to calculate when a comet will round the sun or how a signal traverses a silicon chip. Each step in time provides a peek at the evolution of nature's myriad phenomena.

• • • • • In other words, time is a tool. In fact, it was the first scientific tool. Ancient astronomers meticulously tracked the sun's march across the Zodiac in order to mark off the seasons and determine when to plant and harvest. In this day and age, solar timepieces have been replaced by atomic clocks that, thanks to the steady



pulsing of hydrogen or other atoms, do not gain or lose a second in millions of years. Time can now be sliced into slivers as thin as one 10-trillionth of a second.

But what is being sliced? Unlike mass and distance, time cannot be perceived by our physical senses. We don't see, hear, smell, touch, or taste time. And yet we somehow measure it. Captivated by this conundrum, physicists are beginning to explore the very origins of time. And on first look, they are wondering whether time is a fundamental property of the universe at all. Maybe it is solely a personal experience, set up by our minds to distinguish then from now. As the joke goes, "Time is nature's way of preventing everything from happening all at once."

Such thoughts are more than philosophic. As a cadre of theorists attempt to extend and refine the general theory of relativity, Einstein's momentous law of gravitation, they have a problem with time. A big problem.

"It's a crisis," says mathematician John Baez, of the University of California at Riverside, "and the solution may take physics in a new direction." Not the physics of our everyday world. Stopwatches, pendulums, and hydrogen maser clocks will continue to keep track of nature quite nicely here in our low-energy earthly environs. The crisis arises when physicists attempt to merge the macrocosm—the universe on its grandest scale—with the microcosm of subatomic particles.

Gravity is the weakest of nature's forces: a toy magnet can easily pick up a paper clip against the gravitational pull of the entire earth. But gravity gains collective strength as masses accumulate and exert their effect over larger and larger distances. The force that causes one object to attract another eventually comes to control the motions of planets, stars, and galaxies. And the best

description of how that happens is contained in Einstein's general theory of relativity, introduced in 1915. But the domain in which this theory works is limited; it does not apply to problems at the subatomic scale. For decades, physicists have struggled to discern how gravity acts on the level of elementary particles, a realm governed by the quite different set of rules laid down by quantum mechanics. Arranging this rather curious marriage—an all-embracing theory of "quantum gravity"—is one of physics' last great tasks.

There is a vital reason for physicists' dogged pursuit of this problem. They believe that quantum gravity was the dominant force at the birth of the universe, during the first tiny 10^{-43} second (one ten-millionth of a trillionth of a trillionth of a trillionth of a second). It was an instant when all the matter and energy in the universe was squeezed into a space far smaller than a proton. The microcosm and the macrocosm, in effect, were crushed together in a "singularity," a freakish state where density advances toward infinity and volume approaches zero.

By figuring out the physics of such a bizarre realm, theorists may at last find the key to the origins of the universe, how it came into existence. Simultaneously, they would be learning what lies at the heart of a black hole, the gravitational abyss that is thought to result when the core of an exploding star is crushed inward until its size becomes atomic rather than celestial.

A solution to this mystery, it turns out, lies in understanding the meaning of time: how it acts—and whether it even exists—at the moment of creation or deep within a black hole. Telling time, after all, involves picking out something in the world around you that is changing—the sun rising and setting, pendulums swinging—and tracking those changes to establish a chronology. With a clock, one can determine the sequence of events; and with a sequence of events, one can properly analyze the behavior of a system—in other words, "do the physics." But how do you register time, the most basic widget in a physicist's toolbox, when the entire mass of a stellar

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core is squeezed into a subatomic speck? Or when the entire visible universe is in such a state? What kind of clock could physicists possibly use to deal with the crushing and featureless conditions that marked the universe's birth, when quantum gravity was in control?

The problem is really a mathematical one but can be visualized in this crude way: Imagine you could somehow shift a magical gear into reverse and travel back some 15 billion years to that moment of creation. For most of the trip, a wristwatch would work just fine in keeping track of time. But upon reaching the very cauldron of creation, the watch would melt in a nanosecond. You could still keep track of time through the constant vibrations of individual atoms, the basis of atomic clocks. But go back far enough and even atoms cease to exist. Soon there is no longer any means of measuring the progress of events. During that primordial moment when the force of quantum gravity was strongest and the cosmos was tinier than a nuclear particle, there was essentially no room to place a clock, safe from interference, and gauge how the universe was evolving.

This dilemma summarizes the problem of time in physics. Either theorists come up with a "quantum clock," a means of understanding and dealing with the passage of time in that minuscule province where gravity and the quantum world mingle (at least on paper), or they do away with the concept of time altogether.

"The problem of time is one of the deepest issues in physics that must be addressed," says theoretical physicist Christopher Isham of Imperial College in London. And more than timekeeping is at stake here. There will be no Theory of Everything—no peek at "the mind of God," as the Cambridge University cosmologist Stephen Hawking so famously put it in *A Brief History of Time*—until this mystery is resolved. Time plays such an integral role in most laws of physics that physicists are starting to worry: without a sense of time, a definable clock at the moment of creation, will it be possible to explain all of nature's varied forces with one unified law? The question has been lurking in the background, like some crazy relative hidden away in the attic, as physicists seek that Holy Grail.

NEWTON'S CLOCK TAKES A LICKING

Time became a key word in the language of physics during the seventeenth century, notably when Isaac Newton wove the passage of time directly into his equations, as in *force = mass × acceleration*. Today, it is difficult for any physicist to examine the universe

without thinking of time in much the same way as the illustrious Briton did more than 300 years ago. Most of the laws of physics continue to be written in the style of Newton; they are designed to show how things change from one moment to the next. Each event under study, such as the path of a ball thrown into the air or the thermodynamics of a melting ice cube, is broken down into a series of freeze-frames that, run like a movie, show how nature works.

Newton had placed a clock upon the mantel of the universe. This Newtonian timepiece ticked and tocked, chiming like some cosmic Big Ben, in step with all celestial inhabitants, no matter what their speed or position. That meant that a clock situated at the edge of the universe or zipping about the cosmos at high velocities would register the same passage of time, identical minutes and identical seconds, as an earthbound clock. More important, the Newtonian clock was never affected by the events going on around it. Time was aloof and absolute, alike for all as galaxies collided, solar systems formed, and moons orbited planets. Time led an independent existence, separate from nature itself.

This comfortable notion of time held until the beginning of this century, but then it was shattered with a jolt. Albert Einstein uncovered a glitch in Newton's cozy clockwork. With his special theory of relativity, published in 1905, Einstein showed that a clock at rest and a clock in motion do not necessarily agree with one another. Each registers a different flow of time. This effect is well documented: a muon particle (a heavy electron) racing in from space at near the speed of light, for instance, lives many times longer than a muon at rest on earth. What Einstein did was transform time into a true physical entity, one that was changed by what was going on around it. With special relativity, physicists learned that time is not absolute, as Newton had us think. Time, it turns out, is in the eye of the beholder and in the beholder's surroundings.

Three years after this revelation appeared in print, Einstein's teacher Hermann Minkowski took Newton's clock off the mantelpiece and rolled it out like cookie dough to form the cosmic landscape called space-time. Minkowski, wanting to better explain some of special relativity's



NEWTON:
A MINUTE IS
A MINUTE.

SPECIAL RELATIVITY

*enabled Einstein to transform time into a
true physical entity, one that was changed
by what was going on around it.*

unusual properties, glued space and time together to form a seamless canvas, a new absolute framework in which time becomes physically connected to space. If you think of the space-time coordinates as the interwoven threads of a blanket, tweaking one set of threads will affect all the others: travel near the speed of light and space will shrink as time expands. "Henceforth space by itself, and time by itself, are doomed to fade away into mere shadows," remarked Minkowski.

Time alone can no longer be separated from the mix.

In 1915, with his revolutionary general theory of relativity, Einstein shook up the classical, Newtonian view of time even further.

He took the novel image of space-time and warped it, and in so doing was able to explain the origin of gravity, long a mystery. According to Newton, rocks fell to earth and planets orbited the sun because these objects were somehow held by invisible tendrils of force. Why should this be so? No one knew. But with Einstein's insight, the tendency of one object to attract another object became a simple matter of geometry. It was the natural consequence whenever a mass distorted the space-time canvas. A massive body—the sun, for example—indents the mat (much the way our bodies can sink into a flexible mattress), and nearby objects must then circle it because they are caught, like cosmic marbles, in the deep space-time

basin carved out by the sun.

General relativity treats time very differently from the way it's handled in other areas of physics. Under Newton, time was special. Every moment was tallied by a universal clock that stood separate and apart from the phenomenon under study. In general relativity, this is no longer true. Einstein declared that time is not absolute—no particular clock is special—and his equations describing how the gravitational force works take this into account. His law of gravity looks the same no matter

what timepiece you happen to be using as your gauge. "In general relativity time is completely arbitrary," explains Imperial College's Isham. "The actual physical predictions that come out of general relativity don't depend on your choice of a clock." The predictions will be the same whether you are using a clock traveling near the speed of light or one sitting quietly at home on a shelf.

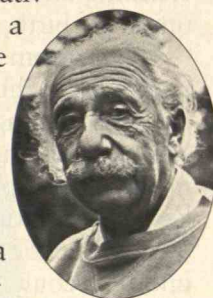
The choice of clock is still crucial, however, in other areas of physics, particularly quantum mechanics. It plays a central role in Erwin Schrödinger's celebrated wave equation of 1926. The equation shows how a subatomic particle, whether traveling alone or circling an atom, can be thought of as a collection of waves, a wave packet that moves from point to point in space and from moment to moment in time.

According to the vision of quantum mechanics, energy and matter are cut up into discrete bits, called quanta, whose motions are jumpy and blurry. They fluctuate madly. The behavior of these particles cannot be worked out exactly, the way a rocket's trajectory can. Using Schrödinger's wave equation, you can only calculate the probability that a particle—a wave packet—will attain a certain position or velocity. This is a picture so different from the world of classical physics that even Einstein railed against its indeterminacy. He declared that he could never believe that God would play dice with the world.

You might say that quantum mechanics introduced a fuzziness into physics: You can pinpoint the precise position of a particle, but at a tradeoff; its velocity cannot then be measured very well. Conversely, if you know how fast a particle is going, you won't be able to know exactly where it is. Werner Heisenberg

best summarized this strange and exotic situation with his famous uncertainty principle. But all this action, uncertain as it is, occurs on a fixed stage of space and time, a steadfast arena. A reliable clock is always around—is always needed, really—to keep track of the goings-on and thus enable physicists to describe how the system is changing. At least, that's the way the equations of quantum mechanics are now set up.

And that is the crux of the problem. How are physicists expected to merge one law of physics—namely gravity—that requires no special clock to arrive at its predictions, with the subatomic rules of quantum mechanics, which continue to work within a universal, Newtonian time frame? In a way, each theory is marching to the beat of a different drummer



EINSTEIN:
GOD DOESN'T
PLAY DICE.



SCHRÖDINGER:
DOES SO.

THINGS

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mechanics.

(or the ticking of a different clock).

That's why things begin to go a little crazy when you attempt to blend these two areas of physics. Although the scale on which quantum gravity comes into play is so small that current technology cannot possibly measure these effects directly, physicists can imagine them. Place quantum particles on the springy, pliable mat of space-time, and it will bend and fold like so much rubber. And that flexibility will greatly affect the operation of any clock keeping track of the particles. A timepiece caught in that tiny submicroscopic realm would probably resemble a pendulum clock laboring amidst the quivers and shudders of an earthquake. "Here the very arena is being subjected to quantum effects, and one is left with nothing to stand on," explains Isham. "You can end up in a situation where you have no notion of time whatsoever." But quantum calculations depend on an assured sense of time.

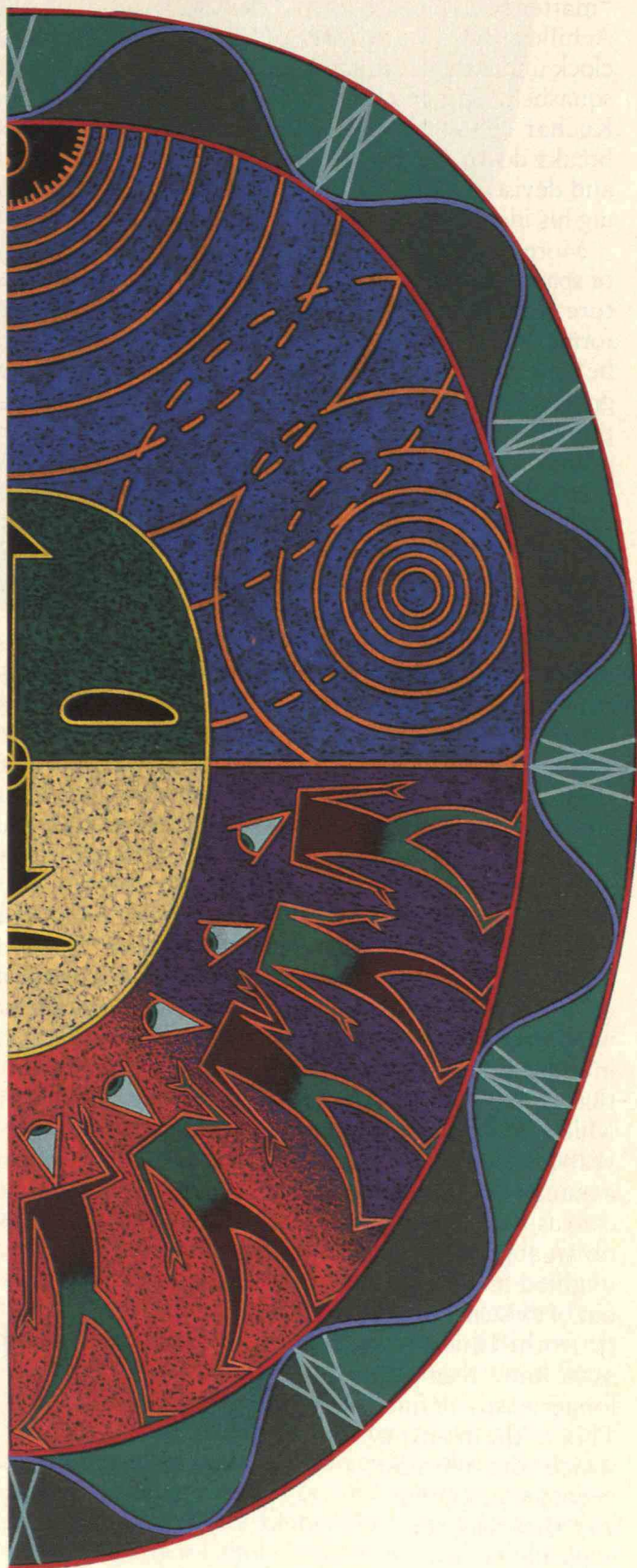
What to do? Different physicists answer the question differently.

CHANGES IN MATTER

For Karel Kuchař (pronounced KOO-cosh), a general relativist at the University of Utah, the key to measuring quantum time is to devise, using clever math, an appropriate clock—something he has been attempting, off and on, for nearly 30 years. Conservative by nature, Kuchař believes it is best to stick with what you know before moving on to more radical solutions. So he has been seeking what might be called the submicroscopic version of a Newtonian clock, a quantum timekeeper that can be used to describe the physics going on in the extraordinary realm ruled by quantum gravity, such as the innards of a black hole or the first instant of creation.

Unlike the clocks used in everyday physics, Kuchař's hypothetical clock would not stand off in a corner, unaffected by what is going on around it. It would be set within the tiny, dense system where quantum gravity rules and would be part and parcel of it. This insider status has its pitfalls: the clock would change as the system changed—so to keep track of time, you would have to figure out how to monitor those variations. In a way, it would be like having to pry open your wristwatch and check its workings every time you wanted to refer to it.

The most common candidates for this special type of clock are simply "matter clocks." "This, of course, is the type of clock we've been used to since time immemorial. All the clocks we have around us are made up of matter," Kuchař points out. Conventional timekeeping, after all, means choosing some material medium, such as a set of particles or a fluid, and marking its changes. But with pen and paper, Kuchař mathematically takes matter clocks into the domain of quantum gravity, where the gravitational field is extremely strong and those probabilistic quantum-mechanical effects begin to



arise. He takes time where no clock has gone before.

But as you venture into this domain, says Kuchař, “matter becomes denser and denser.” And that’s the Achilles heel for any form of matter chosen to be a clock under these extreme conditions; it eventually gets squashed. That may seem obvious from the start, but Kuchař needs to examine precisely how the clock breaks down so he can better understand the process and devise new mathematical strategies for constructing his ideal clock.

More promising as a quantum clock is the geometry of space itself: monitoring space-time’s changing curvature as the infant universe expands or a black hole forms. Kuchař surmises that such a property might still be measurable in the extreme conditions of quantum gravity. The expanding cosmos offers the simplest example of this scheme. Imagine the tiny infant universe as an inflating balloon. Initially, its surface bends sharply around. But as the balloon blows up, the curvature of its surface grows shallower and shallower. “The changing geometry,” explains Kuchař, “allows you to see that you are at one instant of time rather than another.” In other words, it can function as a clock.

Unfortunately, each type of clock that Kuchař has investigated so far leads to a different quantum description, different predictions of the system’s behavior. “You can formulate your quantum mechanics with respect to one clock that you place in space-time and get one answer,” explains Kuchař. “But if you choose another type of clock, perhaps one based on an electric field, you get a completely different result. It is difficult to say which of these descriptions, if any, is correct.”

More than that, the clock that is chosen must not eventually crumble. Quantum theory suggests there is a limit to how fine you can cut up space. The smallest quantum grain of space imaginable is 10^{-33} centimeter wide, the Planck length, named after Max Planck, inventor of the quantum. (To give you an idea how tiny that is, if an atom were blown up to the size of our Milky Way galaxy, which spans some 100,000 light-years, this quantum grain would still be no bigger than a human cell.) On that infinitesimal scale, the space-time canvas turns choppy and jumbled, like the whitecaps on an angry sea. Space and time become unglued and start to wink in and out of existence in a probabilistic froth. Time and space, as we know them, are no longer easily defined. This is the point at which the physics becomes unknown and theorists start walking on shaky ground. As physicist Paul Davies points

out in his book *About Time*, “You must imagine all possible geometries—all possible spacetimes, space warps and timewarps—mixed together in a sort of cocktail, or ‘foam’ . . .”

Only a fully developed theory of quantum gravity will show what’s really happening at this unimaginably small level of space-time. Kuchař conjectures that some property of general relativity (as yet unknown) will not undergo quantum fluctuations at this point. Something might hold on and not come unglued. If that’s true, such a property could serve as the reliable clock that Kuchař has been seeking for so long. And with that hope, Kuchař continues to explore, one by one, the varied possibilities.

“FORGET TIME”

Kuchař has been trying to mold general relativity into the style of quantum mechanics, to find a special clock for it. But some other physicists trying to understand quantum gravity believe that the revision should happen the other way around—that quantum gravity should be made over in the likeness of general relativity, where time is pushed into the background. Carlo Rovelli is a champion of this view.

“Forget time,” Rovelli declares emphatically. “Time is simply an experimental fact.” Rovelli, a physicist employed by both the University of Pittsburgh and the University of Trento in Italy, has been working on an approach to quantum gravity that is essentially timeless. To simplify the calculations, he and his collaborators, Abhay Ashtekar and Lee Smolin of Pennsylvania State University, set up a theoretical space without a clock. In this way, they were able to rewrite Einstein’s general theory of relativity, using a new set of variables so that it could more easily be interpreted and adapted for use on the quantum level.

This was quite an accomplishment; finding a common vocabulary for these two diverse fields was a goal that relativists had been seeking for decades. The new formulation, which is creating a stir within the relativity community, may finally allow physicists to explore how gravity behaves on the subatomic scale. But is that really possible without any reference to time at all?

“First with special relativity and then with general relativity, our classical notion of time has only gotten weaker and weaker,” answers Rovelli. “We think in terms of time. We need it. But the fact that we need time to

GETTING RID

*of time in physical laws would require the
same adjustment as when Copernicus placed
the sun, not the earth, at the center
of the universe.*

carry out our thinking does not mean it is reality."

Rovelli believes if physicists ever find a unified law that links all the forces of nature under one banner, it will be written without any reference to time.

"Then, in certain situations," says Rovelli, "as when the gravitational field is not dramatically strong, reality organizes itself so that we perceive a flow that we call time."

Getting rid of time in the most fundamental physical laws, says Rovelli, will probably require a grand conceptual leap, the same kind of adjustment that sixteenth-century scientists had to make when Copernicus placed the sun, and not the earth, at the center of the universe. In so doing, the Polish cleric effectively kicked the earth into motion, even though back then it was difficult to imagine how the earth could zoom along in orbit about the sun without its occupants being flung off the surface. "In the 1500s, people thought a moving earth was impossible," notes Rovelli. Divorcing time from physics seems equally incredible. No wonder, then, that Rovelli is facing a bit of resistance to his idea. Kuchař, for one, is not yet convinced that time can be so easily dismissed. "We need rules to give the proper restraint to our imagination," he cautions.

But maybe, as Rovelli suggests, the true rules are timeless, including those applied to the subatomic world. Indeed, a movement has been under way to rewrite the laws of quantum mechanics, a renovation that was spurred partly by the problem of time, among other quantum conundrums. As part of that program, theorists have been rephrasing quantum mechanics' most basic equations to remove any direct reference to time.

The roots of this approach can be traced to a procedure introduced by the physicist Richard Feynman in the 1940s, a method that has been extended and broadened more recently by others, including James Hartle of the University of California at Santa Barbara and Murray Gell-Mann of Caltech.



Basically, it's a new way to look at Schrödinger's equation. As originally set up, this equation allows physicists to compute the probability of a particle moving directly from point A to point B over

specified slices of time. The alternate approach introduced by Feynman instead considers the infinite number of paths the particle could conceivably take to get from A to B, no matter how slim the chance. Time is removed as a factor; only the potential pathways are significant.

Summing up these potentials (some paths are more likely than others, depending on the initial conditions), a specific path emerges in the end. Consider a ball being thrown across a street to your neighbor's house. There's a high probability it will take the shortest and straightest route, but others are possible. The ball could steeply arc, for instance; it could swerve to the right or to the left; there's even a minuscule chance it could go around the earth in the opposite direction and hit your neighbor's back door. Each path represents a potential outcome for the particle and contributes to the final result.

The process is sometimes compared to interference between waves. When two waves in the ocean combine, they may reinforce one another (leading to a new and bigger wave) or cancel each other out entirely. Likewise, you might think of these many potential paths as interacting with one another—some getting enhanced, others destroyed—to produce the final path. More important, the variable of time no longer enters into the calculations.

Hartle has been adapting this technique to his pursuits in quantum cosmology, an endeavor in which the laws of quantum mechanics are applied to the young universe to discern its evolution. Instead of dealing with individual particles, though, he works with all the configurations that could possibly describe an evolving cosmos, an infinite array of potential universes. When he



A COMPASS

*is useful only when
it's far from a
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Big Bang.*

sums up these varied configurations—some enhancing one another, others canceling each other out—a particular space-time ultimately emerges. In this way, Hartle hopes to obtain clues to the universe's behavior during the era of quantum gravity. Conveniently, he doesn't have to choose a special clock to carry out the physics: time disappears as an essential variable.

A MATTER OF PERCEPTION

Of course, as Isham points out, "having gotten rid of time, we're then obliged to explain how we get back to the ordinary world, where time surrounds us." Quantum gravity theorists have their hunches. Like Rovelli, many are coming to suspect that time is not fundamental at all. This theme resounds again and again in the various approaches aimed at solving the problem of time. Time, they say, may more resemble a physical property such as temperature or pressure. Pressure has no meaning when you talk about one particle or one atom; the concept of pressure arises only when we consider trillions of atoms. The notion of

time could very well share this statistical feature.

If so, reality would then resemble a pointillist painting. On the smallest of scales—the Planck length—time would have no meaning, just as a pointillist painting, built up from dabs of paint, cannot be fathomed close up. At that range, the painting looks like nothing more than a random array of dots. But as you move back, the dots begin to blend together and a recognizable picture slowly comes into focus. Likewise, space-time, the entity so familiar to us, might take form and reveal itself only when we scrutinize larger and larger scales. Time could be simply a matter of perception, present on the large scale but not on the smallest scale imaginable. Physicists talk of the universe "congealing" or "crystallizing" out of the chaotic quantum jumble that lies at the heart of the Big Bang. Time is not a physical entity but rather a notion that emerges.

Hawking at Cambridge University sees such an effect in his own work on quantum cosmology. To arrive at this conclusion Hawking first had to circumvent the unique and complicated status of time in the space-time continuum. While time can be considered a fourth dimension, it is very different from length, width, and height. In space an object can move freely in any direction—but in time an object must always move forward into the future and away from the past. And this requirement makes the mathematics of quantum cosmology quite complicated. The equations are tough to handle. Hawking decided to get rid of this restriction by treating time as just another dimension of space—a mathematical procedure (trick may be too strong a word) physicists often use to simplify what would otherwise be an intractable problem. The equation has been altered, but its solution can sometimes provide an inkling of the answer hidden in the more complicated equation.

In the 1930s, quantum theorists used a similar approach to figure out how radioactive elements can eject subatomic particles. By all the classical laws of physics, the protons and neutrons within an atom don't have enough energy to break free from the steely grip of an atomic nucleus. But physicists keenly grasped that, in the probabilistic world of the atom, there were small but real odds that a particle could acquire enough energy every once in a while to "tunnel" through its nuclear barriers and fly out of the atom.

Hawking's foray into that nebulous realm where general relativity meets quantum mechanics is suggesting that time, nonexistent at first, could have emerged in an analogous fashion, burrowing into the real world from a domain of timelessness. Thus, there is no reason to inquire what came before the Big Bang. To Hawking, that's as senseless a question

as asking what is north of the North Pole.

There's another way to look at Hawking's result: Time simply loses all meaning as you travel back, closer and closer to the Big Bang singularity, akin to the way a compass starts gyrating and loses its ability to indicate a precise direction as you near the north or south magnetic pole. A compass is useful only when it's far from a magnetic pole; likewise, time may be discernible only after you get far enough away from the Big Bang singularity. Perhaps St. Augustine got it right when he wrote, in the fifth century, that "the world was made, not in time, but simultaneously with time."

Unfortunately, St. Augustine did not reveal by what means, and that is the mystery that is so vexing. Hawking's mathematical procedure offers a glimpse, not a final solution. Physicists as yet only recognize the problem, and sense what must happen, but are far from postulating a mechanism. That awaits a full theory of quantum gravity.

Quantum gravity theorists like to compare themselves to archeologists. Each investigator is digging away at a different site, finding a separate artifact of some vast subterranean city. The full extent of the find is not yet realized. What theorists desperately need are data, experimental evidence that could help them decide between the different approaches.

It seems an impossible task, one that would appear to require recreating the hellish conditions of the Big Bang. But not necessarily. For instance, future generations of "gravity-wave telescopes," instruments just now being built that are designed to detect ripples in the rubberlike mat of space-time, might sense the Big Bang's reverberating thunder, relics from the instant of creation when the force of gravity first emerged. Such waves could provide vital clues to the nature of space and time.

"We wouldn't have believed just 50 years ago that it would be possible to say what happened in the first 10 minutes of the Big Bang," points out Kuchař. "But we can now do that by looking at the abundances of the elements. Perhaps if we understand physics on the Planck scale well enough, we'll be able to search for certain consequences—remnants—that are observable today." If found, such evidence would bring us the closest ever to our origins and possibly allow us to perceive at last how space and time came to well up out of nothingness some 15 billion years ago. ■



**HAWKING:
TIME CAME
LATER.**



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GRADUATE schooling in science and engineering is the crown jewel of American education. The rich talent flowing out of this system has fueled the growth of such key industries as computers, telecommunications, and biotechnology. U.S. institutions confer more than 25,000 advanced science and engineering degrees per year. In 1991 there were in this country 437,000 scientists and engineers with doctoral degrees, almost double the number in 1973.

But all is not well. Almost all of the growth in the U.S. population of science and engineering PhDs in the past decade has resulted from the influx of foreign-born students, large numbers of whom apply their knowledge in their native lands rather than the United States. The portion of doctorates going to students on temporary visas jumped from 18.5 percent in 1983 to 32.1 percent in 1993.

More ominously, the public R&D funding that has driven the growth of the graduate-education system is decreasing. Such research is sponsored largely by the federal government and supplemented by funding from private industry and state governments. Proposals originating in the House of Representatives would cut funding of all non-military R&D 33 percent over the next seven years, in constant dollars. This dwindling pool of money will not only support fewer grad students but also cramp the job market by continuing to lower the number of tenure-track positions in academia. In 1970, 57 percent of the recipients of science and engineering PhDs obtained long-term employment in colleges and universities; this figure had dropped to 49 percent by 1991.

As federal funds decline, the other sectors of the economy that might pick up the slack are failing to do so. Many U.S. companies are cutting back on research expenditures and hiring fewer scientists and engineers. According to the *Wall Street Journal*, six of the largest U.S. corporations—AT&T, General Electric, Xerox, Kodak, IBM, and Texaco—collectively decreased their R&D spending between 1991 and 1994 by \$3.5 billion,

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*To remain
preeminent, graduate
education in science and
technology must adjust to
changing needs.*



ROBERT M. WHITE

or some 30 percent. State governments, too, have been tightening their budgets for academic research. As a result, doctoral production in science and engineering is estimated to exceed employment opportunities by 25 percent, according to a recent study by Stanford University and the Rand Corporation. The level of unemployment among science and engineering PhDs, while still low by national standards, doubled between 1985 and 1993.

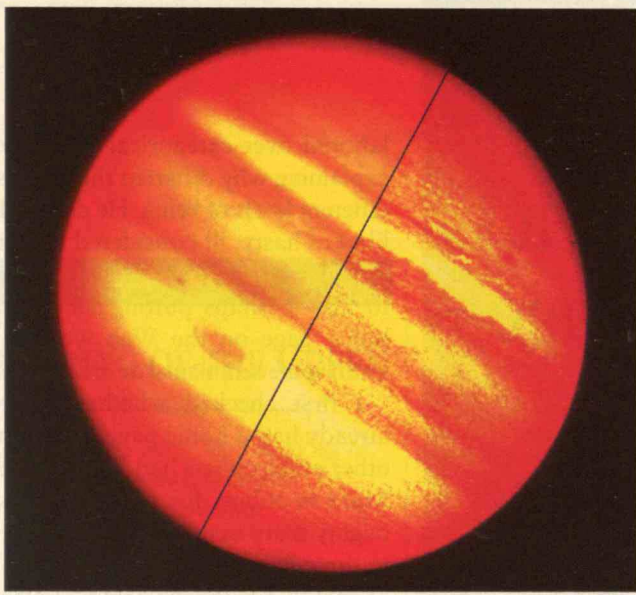
One source of trouble is that the largest category of full-time support for graduate students, accounting for approximately 30 percent of total students in 1991, is research assistantships; students participate in specific research projects under the direction of faculty members who are accountable to the research sponsors. Such training is often highly specialized and narrow and tends not to cultivate the broader skills that industry seeks. The rapid emergence of new specializations, and the brief life cycle of

many products, leads employers to seek scientists and engineers who can easily shift from field to field.

While employers want applicants with breadth and versatility, the graduate education system has been slow to adapt, according to a recent report of the Committee on Science, Engineering, and Public Policy of the National Academies of Sciences and Engineering and the Institute of Medicine. The Committee's report calls for "reshaping" the graduate education of scientists and engineers. It urges graduate schools to provide students with educational experiences in nonacademic settings and in disciplines outside their fields of concentration. The committee also advocates shifting the money available for graduate-student financial aid away from research assistantships and into education and training grants. These grants would be awarded to institutions and departments—not to particular faculty members—thereby allowing students relative freedom to determine the education and training they believe gives them the best opportunities for employment. The committee also suggests that students be educated to realistic expectations of employment—so that they understand, for instance, that job opportunities will increasingly come from industry rather than academia.

These recommendations are not only sound but also should be seen as part of a longer-term effort to break a vicious cycle. For decades, changes in economic and political conditions have resulted in fluctuations in supply of and demand for highly trained scientists and engineers. And, historically, supply of and demand for technical talent have been out of phase. The system has adjusted to such imbalances in the past and is doing so again—albeit with considerable pain. It is no comfort to those being hurt that the marketplace will induce the necessary changes. ■

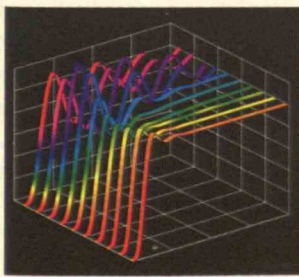
ROBERT M. WHITE is president emeritus of the National Academy of Engineering and senior fellow at the University Corporation for Atmospheric Research in Washington, D.C.



A blurred image of Jupiter (left side), produced by the Hubble Space Telescope before its repair, was corrected with the MATLAB Image Processing Toolbox using an iterative restoration technique (right side). Data: Dr. S. J. Reeves, Auburn University.

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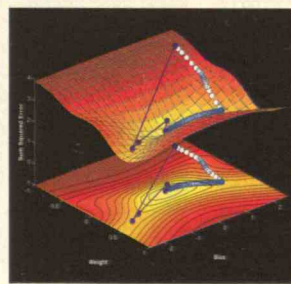
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Of all the technical novelties of the 1990s, there is none so beguiling as the World Wide Web, which seems to put the whole of past and present knowledge at one's fingertips. Offering pictures, words and sounds, the Web carries us into an alluring realm where satisfaction is always just a mouse click away. But as today's cybernauts fly gleefully from one Web site to another, a vexing question looms: How does anyone judge the quality of what the computer so magically reveals?

One moves about on the Web from item to item as if floating on some vast horizontal plane, where all items possess a strange equality. Web-browsing software, which enables the user to leap from one information node to another by pointing a cursor at a section of highlighted text, resists making distinctions between matters weighty and trivial. Enter a term like "feline maladies" and you're as likely to get a picture of a Scottish woman's pet cat as you are to receive research reports on animal diseases from the American Association of Veterinary Anatomists—it's all "information" to a Web browser.

Any serious inquiry involves sorting and sifting in quest of genuine quality. In the world of print, most of us have learned to recognize the difference between primary and secondary sources, between scientific reports and journalists' coverage of the same topics. In my own work, I've learned to make subtle evaluations about similar publications, noting the qualifications and intellectual standards of editorial staffs, for example. I've become expert at "reading" the quality of paper stock; the texture, even the aroma of pages says something about how much care went into a book's production.

Because these familiar cues to quality are largely absent on the Web, we will have to find new ways to assess the value and credibility of information we find there. The Web's hypertext structure slices through long-standing conceptual hierarchies like a hot knife through butter. Monuments of knowledge, compli-

cated distinctions that took decades to erect, are reduced to a set of endlessly malleable hot links. Over the long term, arranging information in this way may help reveal unexpected connections between diverse realms of knowledge and stimulate the imagination. But for now, there will continue to be a great deal of confusion and futile effort; reports frequently arise of wasted afternoons spent plowing through the Web trying to find that one morsel of useful information amidst the vast reservoirs of gossip, rumor, and political propaganda. Hope springs eternal; with all this horse manure, there's just got to be a pony in there somewhere.

As I pondered this predicament recently, I picked up a volume by Aristotle, whose well-measured, reasoned discourse made him a model of Western intelligence for two millennia. Aristotle's writings move in careful steps—he

Aristotle Needs a Web Page

*He carefully
structured all the world's
knowledge; what would
he make of a medium
that indiscriminately
links the trivial to
the weighty?*



LANGDON WINNER

labored over categorical distinctions, explaining why different things exist at different levels of being. He despised the kind of hasty, ill-considered logic that prevails on the Web. Then it occurred to me—perhaps putting an Aristotle home page on the Web would help instill some semblance of order.

I first checked whether Aristotle already had a home page. I knew that other philosophers had Web sites; Karl Marx is online, for example, looking mighty sharp in that woolly beard, ready to download his ponderous tomes free of charge. I typed the name "Aristotle" into my browser to see what would happen. Back came several choices. One turned out to be a digital archive in Delft, Holland, filled with photographs on art, nature, space travel, and many other subjects. Aristotle, a collector of diverse specimens useful in his scientific work, would have enjoyed this. As I read further down the page, I came upon this message: "The porn stuff is not accessible anymore...it attracted 10,000 people daily, too much to handle." Alas, on the Web you're never more than one click away from garbage. Those who wander through this strange new world will have to get used to its capricious connections, affirming their own standards of quality even as the Net resists them.

Aristotle might have warmed to the challenge. Two thousand years ago, The Philosopher faced a sprawling mass of natural and social data, using careful observation and the power of reason to produce order. An Aristotle Web page worthy of the name would attempt something similar. Drawing upon the best tools of modern librarianship, it would link materials in logical fashion, offering visual cues as to which sources are "popular" or scholarly, separating Internet dross from works of real substance. Beyond today's fascination with "cool sites" lies the need to create tools for inquiry that favor intelligence over confusion and absurd spectacle. ■

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Reviews

BOOKS

IMPAIRING OF THE GREEN

A Moment on the Earth: The Coming Age of Environmental Optimism
by Gregg Easterbrook
Viking, \$27.95

BY KATHLEEN COURRIER

BOOKSELLERS and other bellwethers of American political taste reported environmental fatigue after the twentieth anniversary of Earth Day in 1990. In newspapers, column inches devoted to the environment have since been given over to reporting on the economy and other issues. Rainforest chic in particular has petered out, though deforestation continues. This spring, "save the rainforest" captured a *Publisher's Weekly* dubious achievement award for most tired theme for a children's book.

Then along comes veteran environmental reporter Gregg Easterbrook's *A Moment on the Earth* with the news of how much better things are getting than crusaders would have Americans believe. Easterbrook ranks environmentalism "among the most welcome social developments of the twentieth century." But he also claims that over the last decade it has gone pinstripe, grown misanthropic and uncompromising, favored direct-mail hyperbole over sound science, and fallen under the spell of nostalgia for a green-gold past that never was. Worse, he says, it has denied that progress has occurred on the environmental front and led taxpayers deeper into debt and confusion by exaggerating threats.

On a few counts, Easterbrook gets it right. Some Washington-based environmental groups have joined the political mainstream, relying on mass media and mailings and giving up the credibility of the outsider for the access of the insider. Egged on by environmental advocates,



the media *did* overamplify scares over dioxin, asbestos, and, more recently, the pesticide Alar used on apples. And ecologists *are* furiously debating such issues as what a "natural state" is and how fragile and stable various ecosystems are, so environmental Chicken Littles (as Easterbrook calls them) may indeed find themselves politically stranded by new scientific evidence that nature abhors a standstill or loves a good fight.

Yet Easterbrook commits so many errors of fact and judgment that his efforts to show how environmentalists don't give sound science or logic their due backfires. He confuses global and regional temperature trends, economic growth and economic development, methanol-burning vehicles and zero-emission vehicles. He credits the Pollution Prevention Act, which passed in 1990, with lowering the output of toxic wastes in the late 1980s. He says that reactor plutonium can't be used to make bombs (it can) and implies that humans have natural resistance to radiation beyond background levels (they don't). Criticizing environmentalists for undocumented overstatement, Easterbrook asserts without citation that they predicted all trees in Eastern American forests would die from acid rain. A con-

vincing 52-page report by the Environmental Defense Fund on Easterbrook's mistakes and misunderstandings in only 4 out of 38 chapters—those on global warming, natural radiation, the spotted owl, and species—suggests just how low the book's signal-to-joyful-noise ratio is.

More important, the environmental movement as a whole is neither as hysterical nor as monolithic as Easterbrook makes it sound. Gaffes and oddballs are not hard to find in a 30-year-old social movement involving millions of people, and Easterbrook relishes lighting fires under straw men. Who wouldn't be suspicious of the few he has found who think bears have a right to eat joggers, who hate loggers mainly because their slow-moving trucks cause traffic jams around ski resorts, or who think African farmers look better behind cattle-drawn plows than atop tractors?

In fact, Easterbrook is so busy hunting warts that he misses or glosses over deeper problems raised by more astute observers of the environmental movement. For instance, he no more than nods at the gender and class splits that critics such as University of Vermont geographer Joni Seager and former *Mother Jones* editor Mark Dowie have pointed out between mostly middle- and working-class female grassroots groups and national environmental organizations headed up by better-off men. And he appears oblivious to the intramural rift Duke University professor Martin Lewis describes between "Arcadians," who are basically anticapitalist anarchists, and the more numerous "Prometheans," who embrace technological progress, gradual political reform, and economic growth.

Optimism as a Novelty

Curiously, Easterbrook seems to think that he alone carries the Promethean message and that it's news. From his (mis)reading of environmental literature and the environmental movement, he divines that we need a corrective doctrine of "eco-realism"—one relying on logic, an accurate understanding of envi-

ronmental conditions and trends, and an effort to "think like nature." As it happens, this approach has been common currency within large segments of the environmental movement for 15 to 20 years.

Even the optimism the author sells as a novelty runs deep within the movement: the belief that people can change course for the common good is profoundly optimistic and not at all at odds with the looking-for-trouble mindset thoughtful greens share with good doctors and airplane mechanics. If Easterbrook had understood as much, he might not have misjudged DDT's legacy; as it is, he misses the key point that the spring hasn't yet been silent partly because Rachel Carson warned of the possibility that it might be.

Granted, few environmentalists are as

sanguine as Easterbrook about the nature or pace of political change—he believes that pollution in the industrialized countries of the North will end within our lifetimes, for example—but such extremely rosy views may be unwise. Arguably, the progress Easterbrook trumpets would slow or stop without continued vigilance and activism.

Easterbrook's born-again optimism stems from his awe of nature's strength compared with ours. One of this book's main themes, which flickers in the title, is that human beings are relative newcomers on the planet and not nearly as powerful or mischievous as they imagine. But the author's long forays into pre-human history and natural disasters, including cosmic showstoppers to come, offer only cold comfort to those who care about this generation and the next two or three. And any dampening effect that Easterbrook hopes to have on hubris goes out the window with his space flights of fancy about how to deal with worst-case scenarios: he suggests colonizing other planets and turning earth into one big nature preserve should the need arise.

Easterbrook does deserve a prize for sheer nose-for-news, pulse-of-the-nation brilliance. He recognizes the public's yearning to get the big picture and to distinguish threats from nuisances and emergencies from trends. Responding to that yearning, he has found an approach to environmentalists not yet overplayed in the media—that of a parent administering "tough love" to a pack of children whose whining has got out of hand. Still, he doesn't understand environmentalism's early-warning function, or the movement's inevitable evolution from a novel to a permanent political concern, or even what's on most environmentalists' minds, much less anything about how nature works that eco-advocates haven't also been grappling with. The result is that his good news and supposedly tough-minded advice ring fatuous. ■

KATHLEEN COURRIER directs the publishing program at the World Resources Institute.

BOOKS

SHEDDING LIGHT ON COMPLEXITY THEORY

*The Quark and the Jaguar:
Adventures in the Simple and the Complex*
by Murray Gell-Mann
W.H. Freedman and Co., \$23.95

BY ROBERT J. CRAWFORD

THE "reductionist" scientific method, which seeks an underlying blueprint for everything in nature, has dominated the last three centuries, leading researchers to see all phenomena in terms of the simplest, most basic rules that govern them, and the results of studies informed by such thinking have been frustratingly incomplete at times. Molecular biologists, for example, have isolated DNA, but they have not been able to adequately explain deeper riddles, like embryonic development: no simple formula can clearly predict which of two cells with the same DNA will become a knuckle and which will become a fingernail. To overcome these shortcomings, many scientists are calling for a theory of "complexity" that would focus on systems where order often appears to organize itself from a bewildering number of interacting factors.

But in *The Quark and the Jaguar*, Nobel laureate physicist Murray Gell-Mann argues that complexity theory actually complements the reductionist approach. The quark represents the simple and universal, in his view—that which reductionist science is eminently equipped to explain. He suggests that it leads in an unbroken chain to the complex, as symbolized by the elusive jaguar. Gell-Mann attempts to build his version of complexity theory around what he calls the "complex adaptive system," which "acquires information about its environment" and identifies "regularities in that information." Those

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regularities are then condensed into "a kind of 'schema' or model." But unlike the models of reductionist science, these are not static. Instead, the system continues to evolve, testing and discarding competing schemata as conditions change.

All complex adaptive systems possess three "strands," Gell-Mann says: basic rules, "frozen accidents," and the selection process. For instance, the basic rules upon which human language depends derive from "biologically evolved, neurologically pre-programmed constraints," which are the basic organs and cognitive abilities that enable humans to communicate. But many features of grammar, such as the relative positions of verbs and direct objects, are possible within these constraints; the "frozen accidents" of history determine which ones persist. Finally, the selection process comes into play as languages develop new vocabulary and modes of expression to adapt to different circumstances.

Much of Gell-Mann's book is devoted to exploring what he believes are other examples of complex adaptive systems; it is a panoramic though cursory excursion through human knowledge. Gell-Mann examines the evolution of ecosystems, bacterial genes, human societies, and a child's brain. One of his main goals is to encapsulate a vast array of puzzling phenomena in a brief and elegant theory, much as the Scottish physicist James Clerk Maxwell proved that electricity and magnetism were in fact aspects of the same force.

He also hopes to guide scientists into a more holistic and cross-disciplinary approach. Gell-Mann believes that the study of complex adaptive systems, with its attention to historical development and links between the simple and the complex, will bridge the gaps separating physics, chemistry, biology, and perhaps even the social sciences. To advance this agenda, he has helped found the Sante Fe Institute, where "complexologists"—biologists, computer scientists, economists, and other scholars—meet to exchange ideas.

At its best, *The Quark and the Jaguar*



is a window into a great scientific mind, replete with fascinating miniature essays on topics such as the relationship between quantum physics and chemistry. The particles and forces involved in physics, Gell-Mann explains, can be used to derive the laws of chemistry: the way electrons interact with nuclei and other electrons determines the course of most chemical reactions. In this sense, chemistry can be reduced to physics, which is more "basic." Yet many chemical reactions occur only under special conditions, like a certain temperature and atmospheric pressure, and these facts must be "fed into the equations of particle physics" to complete a practical description of reality.

Unfortunately, however, Gell-Mann is an uneven writer. While many passages are gracefully written, others are impenetrable, at least to lay readers. He notes, for example, that "for [each set] of fine-grained histories it is possible to consider many different coarse grainings and to ask which ones, if any, lead to a maximal quasi-classical domain characterized by decoherent coarse-grained histories that exhibit nearly classical behavior, with continual excursions and occasional large ones."

And on a more fundamental level, *The Quark and the Jaguar* fails to critique the

research agenda of the complexologists, who so far can't even agree on a definition of complexity. Some argue that "computational capacity"—how much information a system can store and process—is an accurate measure of complexity. Others contend that a definition somehow involves the emergence of new systems at "the edge of chaos," or on the "border" between randomness and regular order, like that of a crystal lattice. Similarly fuzzy measures of complexity include entropy, or the level of disorder in a system; "thermodynamic depth," or the energy resources required to create a system from the ground up; and "fractal dimensions," or the degree of detail that repeats itself at smaller and smaller scales. With such great disagreement about what complexity actually is, the task of figuring out how to study it and what questions to ask is clearly subject to failure.

Moreover, the reader suspects that the complex adaptive system, which Gell-Mann is at pains to establish as a unifier of complexity studies, may say too little about too much. Nothing, it seems, can escape Gell-Mann's eye, from fish raining out of the sky to New Age philosophy. But in the end, he does not convincingly tie together the myriad of subjects he addresses.

At a time when some of the founding complexologists, such as University of Chicago mathematical biologist Jack D. Cowen, are beginning to doubt that they can create a meaningful science of complexity, Gell-Mann could have offered a measured appraisal of the field. With the unique breadth of his knowledge, he might have extracted some meaning from the jumble that complexity theory has become, quelling fears that it may be degenerating into discussions between computer hacks. Instead, he has chosen to plow forward with his pet theory, the complex adaptive system. The task of examining complexity—and perhaps making some sense of it—will fall to someone else. ■

ROBERT J. CRAWFORD is assistant director of the Office for Sponsored Research at Harvard.

SAVE THE MOVIES

Vincent Kiernan succinctly reports in "Preserving Movies" (*Trends*, TR April 1995) that movies recorded on any type of film



are in danger of being lost forever. But although he laments that the logistics of making digital copies appear prohibitive—"a 90-minute movie feature film might require 7.5 tera-

bytes of storage, the equivalent of 5.2 million floppy disks"—there are alternatives.

Already available at a reasonable cost is software that can match the image resolution and color depth of the original movie and reduce storage size to 50 giga-

bytes, which can be placed on 10 to 20 of the advanced CD-ROM discs. If the lower image resolutions and color depths of high-definition TV were acceptable, a compressed film could amount to 25 gigabytes or less, the equivalent of 5 to 10 CD-ROM discs. Although some purists are known to refuse to consider any reduction in quality whatsoever, the alternative, losing the movies altogether, demands a compromise.

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HANDLE WITH CARE

Since I am convinced that we need to find effective ways to educate young people about science, I was pleased to read "Integrating the Science Curriculum" (*Trends*, TR May/June 1995). However, the conditions depicted in the accompanying photograph are quite distressing.

A man in a white smock is surrounded by an attentive group of students while he pours something into a beaker. Less than two feet from the beaker is a bottle that is clearly labeled acid. Not only is the instructor not wearing protective gloves, but not a single person in the picture is wearing any kind of eye protection. As someone who has seen chemistry experiments go awry—sometimes with explosive results—I am sensitive to safety in the laboratory. Those in the photograph obviously are not. At a minimum, the precautions that I have mentioned should be taken. At best, such work should be done under a fume hood.

TIM BOHRER
Milford, Ohio

A DIFFERENT TAKE ON EASTERN EUROPE

While Alice H. Amsden attempts to pinpoint some of the elements responsible for the economic collapse of former East Bloc nations in "Eastern Europe: Putting Some Government Back in Manufacturing" (*TR* July 1995), my experience in the region with the U.S. Agency for International Development indicates a far more complex, and sometimes intractable, situation.

One problem is that Amsden generalizes about the region in the typical thought pattern of the Cold War. But the fact that each country has a unique social and historical background, including an individualized slant on the not-so-monolithic Communist system, accounts for much of the remarkable difference in economic performance we see now between the Czech Republic and the Republic of Georgia, for instance.

The author also overlooks the great and obstinate power of the mafia and other criminal economic groups that have accumulated large amounts of capital. Private Russian deposits in Swiss banks have reportedly totaled more than \$50 billion during the past four years—more than all the foreign aid delivered to Russia during the same time period. If these sums were reinvested domestically in productive assets, the economic outlook of Russia would change dramatically.

As the author implies, much Western foreign aid to the region has been devoted to consulting services. These accountants and academics have often provided theoretical rather than practical advice. Meanwhile, even though Eastern Europe's textile and agriculture industries can compete in the global marketplace without further investment or advice, the West has prevented their entry through cartels and protectionist policies.

Since most of the large state-owned enterprises (SOEs) are nothing more than organized scrap yards, neither foreign nor domestic investors are interested. Thus Amsden's notion that SOEs be given another chance would be far more costly in terms of time and money than starting from scratch.

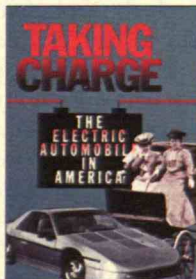
The author's suggestion that Eastern Europe should look to East Asia for instruction in economy building is also flawed. The elite of East Asia have always been capitalists par excellence because of educations in the West, substantial domestic capital funds, and a compliant work force that asked for little more than a full belly. In contrast,

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the East Bloc's elite possesses a relatively poor and politically oriented education, no capital, crumbling infrastructure, and a work force accustomed to economic security at the expense of profits.

No matter how much the people protest or the apparatchiks squirm, the countries of Eastern Europe must create their own structural conditions favorable to economic growth. For guidance, the so-far-unsuccessful countries need to look no farther than Poland,

Hungary, and the Czech Republic.

In those nations, privatization has been a roaring success not only in and of itself, but also because it forced basic structural reforms including contract law, bankruptcy law, the free trade of stocks, and standardized accounting rules. Such an atmosphere birthed entrepreneurship, which is even better. Those nations that privatized fastest and most completely have had the most economic success.

But even these countries still need the West's help in the form of infrastructure investments. How can any type of business prosper with random, sometimes daily, shutdowns of utilities, when maintenance of public facilities is virtually nonexistent, and when educators have neither the training nor the materials to teach students about Western business and economics? The West also needs to restructure its own policies so that Eastern Europe can export its competitive products, thereby earning hard currency and self-respect. After all, many of the 500 million people in this region are becoming increasingly desperate. If they start moving west, the consequences will not be pleasant.

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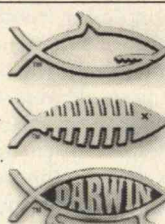
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Phenomena

BY DAVID BRITTAN

Mr. Mens, Meet Mr. Manus

My pal Dickie, an accomplished woodworker with whom I sometimes collaborate in the role of slightly retarded apprentice, likes to satirize the lowbrow status of his craft. Explaining some technical point, he'll say archly, "It's all in Barclay's monograph on beveling," or "Surely you've read Wallace on studs." Then we'll both have a good laugh and go back to our scraping and banging.

As it happens, there really is a classic literature of wood-working. Asher Benjamin, a Boston builder of the early nineteenth century, summed up his wisdom in volumes such as *The Builder's Assistant* (1800) and *The Practical House Carpenter* (1830). Minard Lafever, who signed himself "architect and practical builder in the City of New-York," published *The Young Builder's General Instructor* in 1829. It was intended as a follow-on to the copious writings of the British builder Peter Nicholson—the Bob Vila of his time—whose name was known to all who shoved a plane.

Naturally, these books are full of helpful hints. They offer rules of thumb for sizing newel posts and gluing planks, and tips on fitting veneer to a curved surface ("prepare a quantity of hot water and put the veneer into it, and there let it remain until it becomes as soft as a piece of leather"). But more than that, they offer geometry. Reams and reams of geometry. To read Nicholson on hand-rails is to wrestle with pages of tricky operations on line segments and with diagrams so elaborate you might think you were splitting atoms, not wood.

Contrary to its image, wood-working is not all handiwork. In fact, the more one learns

about it, the more one wonders why it is classified as a manual trade—and the less one wonders why it has been a haven for rebel intellectuals. Although parents may despair when their child throws over a prep-school or Ivy League education for a career as a carpenter or joiner, and although the ranks of woodworkers are swollen with refugees from physics and English Lit. whose former colleagues grumble that a mind is a terrible thing to waste, working with wood is as much a mental activity as a manual one—as much *mens* as *manus*. There are no minds wasted here.

The Euclidean mysteries of joinery and construction are one thing—the dovetail or mortise-and-tenon joints that divide fine furniture from cheap, the well-fastened beams that divide solid dwellings from deathtraps. But the tools and materials are a study in themselves. They are quirky enough to challenge the keenest intellect and completely baffle the rank beginner (that would be me).

On short acquaintance with the craft, I will venture my own rule of thumb: the simpler the tool, the harder it is to use. Electric table saws and routers afford speed, precision, and a comfortable distance from the mechanical properties of the lumber. Handsaws, planes, and chisels force you to experience wood at the level of cellulose fibers and resin—as bundles of splinters, in other words—and grant success in direct proportion to your skill. It is with such humble implements that woodworkers spend the bulk of their time.

Because the tools of the trade have changed little since the Romans, a body of lore has had a couple of thousand years to grow up around each one. For example, a clean cut does not saw itself; it may require any number of cunning devices—from a wedge placed in the kerf (the slit made by the saw) to

keep the saw from binding, to a line of masking tape that prevents plywood from splintering—all of which the woodworker must learn or be laughed off the shop floor.

These subtleties are multiplied by the number of subspecies into which each tool has branched. There's the firmer chisel (firmer than what, I couldn't tell you), which has a flat blade without a bevel. The mortise chisel is for cutting rectangular holes, or mortises, in furniture legs. The pocket chisel is not at all what it sounds like (it resembles the firmer chisel but has a beveled blade), the butt chisel even less so. Then there are those cousins with hollowed-out blades, the gouges. And the saw's taxonomy would fill several pages.

Sandpaper is the simplest tool and also the most dangerous, especially in the hands of an amateur. The cherry mantelpiece I just completed appears ravaged by time. "It looks like a real antique," says Dickie, putting the best face on things. But age alone could not account for flaws like these. I have sanded down crisp corners, thinking I was doing the wood a favor. I have rubbed right through the thin veneer on an expensive piece of cherry ply, leaving a bald spot that Dickie has been good enough not to mention. I have overlooked the milling marks created by the lumber yard, allowing them to soak up dark stain in the pattern of a bar graph. I have even made ripples on surfaces that were once calm. Obviously, I

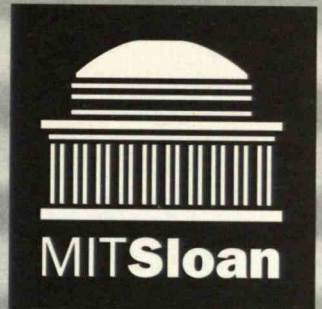
should have read Spence and Griffiths on the importance of the sanding block: "Never use just your hand to hold the abrasive paper when sanding flat surfaces," they warn in a latter-day handbook. "This will sand away the softer part of the wood, giving a wavy surface."

From time to time I fantasize about an alternative career in furniture making. It must be satisfying to create lovely, use-



ful objects that you know will outlast you, and to tax your mind in the process. But the motto of Gustav Stickley, the great turn-of-the-century furniture designer, is a strong deterrent: "The lyf so short, the craft so long to lerne." If I apply myself now, I might manage a decent rocking chair by the time I need one. ■

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